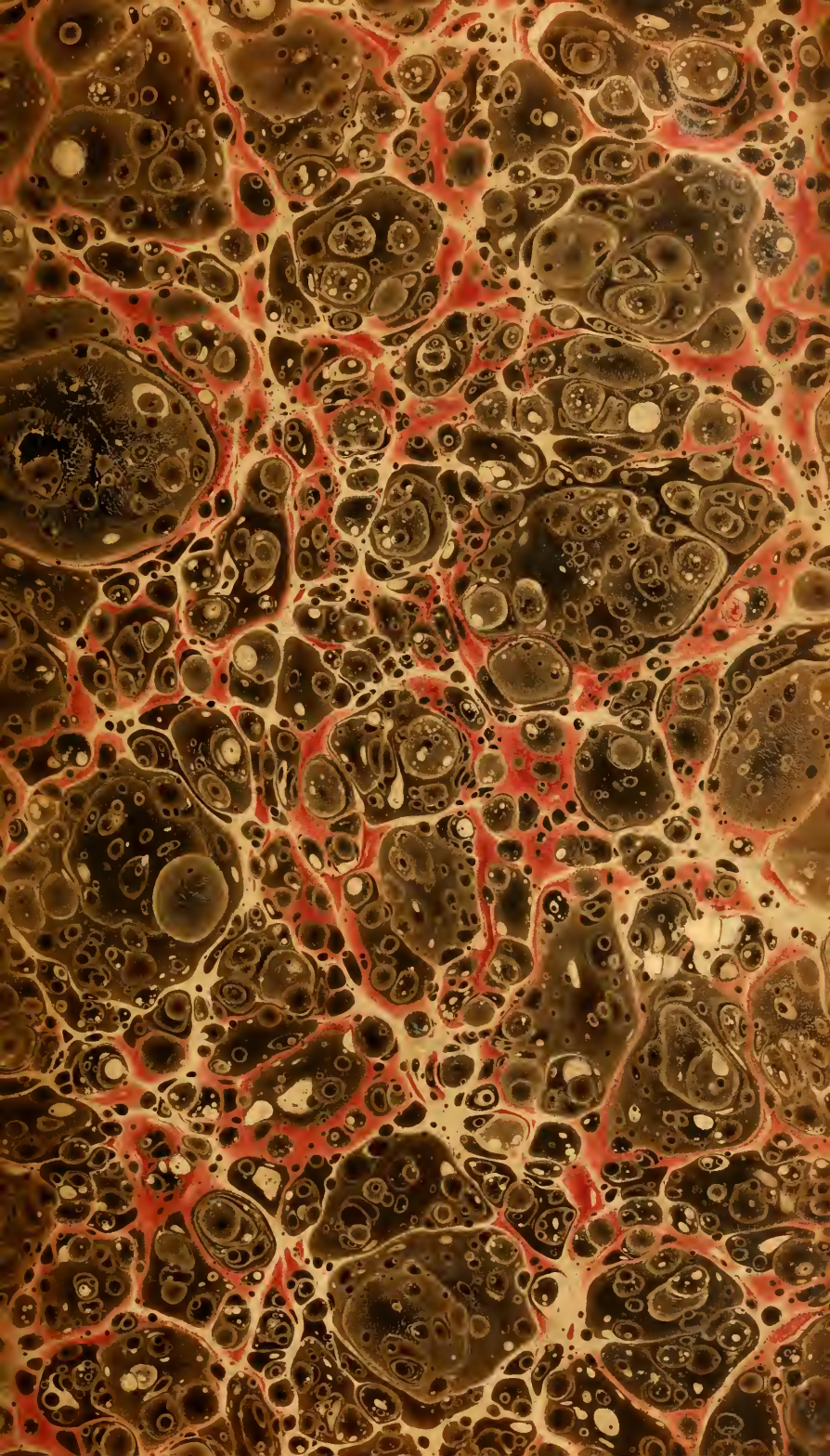
YALE MEDICAL COLLEGE

LIBRARY.

No.

TRANSFERRED TO
YALE MEDICAL LIBRARY



Digitized by the Internet Archive
in 2012 with funding from
Open Knowledge Commons and Yale University, Cushing/Whitney Medical Library

http://www.archive.org/details/treatiseongunsho00guth

A

Treatise on Gun-shot Wounds,

ON

INFLAMMATION, ERYSIPELAS, AND MORTIFICATION,

ON

INJURIES OF NERVES,

AND ON

WOUNDS OF THE EXTREMITIES

REQUIRING THE DIFFERENT OPERATIONS OF AMPUTATION;

in which

The various Methods of performing these Operations are shown, together with their After-Treatment;

and containing an account of

The Author's successful Case of Amputation at the Hip-Joint,

&c. &c. &c.

WITH FIVE EXPLANATORY PLATES.

Being a Record of the Opinions and Practice of the Surgical Department of the British Army, at the Termination of the Wars in Spain, Portugal, France, and the Netherlands, in 1814 and 1815.

BY G. J. GUTHRIE, F.R.S.

Surgeon to the Westminster Hospital and to the Royal Westminster Infirmary for Diseases of the Eye; Consulting Surgeon to the Western Dispensary for the Diseases of Women and Children; Deputy Inspector of Hospitals during the Peninsular War; Doctor in Medicine in the University of Aberdeen; Associate of the Medical Societies of the Faculty of Paris; Lecturer on Surgery, &c. &c. &c.

THE THIRD EDITION.

LONDON:

PRINTED FOR BURGESS AND HILL, MEDICAL BOOKSELLERS,

GREAT WINDMILL STREET, HAYMARKET.

1827.

RD96.3
827 G

LONDON:
PRINTED BY CHARLES WOOD,
Poppin's Court, Fleet Street.

TO THE KING.

SIRE;

In presuming to offer this work to your Majesty's notice, and to send it forth under the sanction of your Majesty's approbation, I have been actuated by the feeling, that however glorious the war to which it alludes, still the signal successes which attended your Majesty's arms, and led to its happy termination, were not acquired without losses, which cannot have failed to leave a painful recollection in the breast of your Majesty. It will be some alleviation of this regret to know, that these very losses have been conducive to the comfort and safety of others of your Majesty's subjects, from the

improvements they have given rise to in the art and science of Surgery, of which this work, on all the subjects of which it treats, is a record. It is the knowledge of this fact alone which has led to its being laid at the feet of your Majesty, by

Your Majesty's

most devoted and faithful

Servant and Subject,

GEORGE JAMES GUTHRIE.

PREFACE.

When I printed the first edition of this work in 1815, I stated, that it contained "many opinions in opposition to those received in common by the profession, and even now taught." I also said, that in publishing them I was desirous of making known "what had been the practice of the surgeons of the British Army during the Peninsular war, and to preserve for them the credit of improvements, which they alone have introduced into the science and art of surgery, and particularly in the operative part, in which they have been eminently successful." In referring to my professional brethren that credit which was their due, I by no means wished to exonerate myself from any blame that might be attached to the practice recommended, for I was aware that some of these opinions were not common to the whole, and for these in particular, as well as for every one of them, I held myself responsible. I was contented to allow them to find their way as unobtrusively as possible

into the world, satisfied they would stand the test of investigation, and be ultimately adopted as principles. In this I was not mistaken; they have not only been generally adopted, but pirated by some persons, and even advanced as something new by others, many years after I had published them. In order to put a stop to such proceedings, I shall now enumerate those points in which surgery is indebted for its improvement to the medical department of the army and the practice of the Peninsular war; and in so doing I trust I shall redeem the pledge given to the medical officers of the different branches of the public service, in the Introductory Lecture to my first course of Lectures on Surgery in 1816, that I would always defend and maintain their right to the improvements they had suggested or made against all encroachment.

Previously to the termination of the war in 1815, and the appearance of the first edition of this work, the opinions of Mr. Hunter on the powers and capabilities of the human constitution were universally received. As general principles they did little mischief; but when they came to be acted upon, the results were not found to coincide with the principles from which they were deduced. When an injury had occurred to a person in health, rendering the loss of a limb necessary, he recommended that an operation should not be

performed until after suppuration had been established, a period probably of six weeks, which, even if the patient survived, was often found to be too late to be serviceable. From the failure of this practice, the contrary one of immediate amputation became gradually more general during the war, and at its close, I not only advocated and established the propriety of it, but examined the reasoning on which Mr. Hunter's opinions were founded, and I trust have proved it to be defective. That it was so ought indeed to have been presumed, when the facts were found to be opposed to the reasons.

It was not however on the single point of amputation that this reasoning led into error, it embraced the whole subject of inflammation and its consequences, which I believe can only be consistently viewed on the principles regarding the human constitution which I have advanced. The variations in the nature and appearances of Erysipelas may through them be more easily comprehended, and the treatment of mortification more scientifically undertaken. The Baron Larrey had shown, that in gangrene from wounds, amputation might occasionally be resorted to with success during its progress, in opposition to the received opinions of the schools; but he did not explain that this was entirely dependent on the circumstance of its being local. The division I have made into

constitutional and local mortification, and the practice I have indicated to be followed in the different species of gangrene, from whatever causes they may have originated, as dependent on this distinction, are improvements which many are inclined to adopt, without being aware to whom they are indebted for them. There is still however an unaccountable slothfulness in some in neglecting all inquiry into this subject, whilst there is in others an obstinate adherence to the old practice, although invariably unsuccessful.

The practice of the Peninsular war led however to another important result in surgery; it dissipated that delusion, which had so long obtained possession of the minds of surgeons of every description, "that it was impossible to command the flow of blood through the great arteries." I overturned at once this hypothesis, declared it to be visionary, and not only without foundation, but the reverse of fact. On the return of the medical officers of the army to London in 1814, it was not a little amusing to them to hear teachers of surgery gravely informing their students, that amputation at the shoulder-joint was a most formidable operation, on account of the impossibility of effectually preventing the flow of blood through the arteries; and when they did notice amputation of the hip-joint, it was only to declare it a murderous ope-

ration. What is the state of things now? What has the short space of twelve years done for this branch of surgery? Why almost too much. The facility with which these operations can be performed, and the safety which attends them, has been shown, and all alarm has been banished from the minds of surgeons on these points. It is now to be feared, that they may become unmindful of the precepts I have laid down, demonstrating their necessity, and recommend them to be performed when others less important might suffice.

The practice of the Peninsular war was decisive on many other points. It overturned the application of the theory of aneurism to the treatment of wounded arteries; and my paper on wounded arteries, published in 1811, in the New Medical and Physical Journal, demonstrated the necessity which existed for performing the operation at the wounded part of the vessel, and not at a distance. It showed, what is not yet well understood by many, that in no case (and this is without any exception) should one ligature above the wound be depended upon, but that another should be applied below it.

I have proved from official documents, that the great dread entertained of secondary hæmorrhage in Gun-shot Wounds was groundless, whilst the practice in all cases has been established on more certain

principles than heretofore. These and many other minor points I do not think it necessary to notice. A careful examination of the books which existed at the commencement of the Peninsular war, and a comparison of them with the observations there made on the same subject, will show in what part the alterations and improvements have taken place; whilst the work, from its continual reference to the different periods of the war, demonstrates the fact of the particular time at which each of them was established, if it does not mark that at which they originated.

2, Berkeley Street, Berkeley Square,
June 18, 1827.

CONTENTS.

ON GUN-SHOT WOUNDS.

Classification of Gun-shot Wounds into eight Classes or Divisions.

1. *Of Simple Gun-shot Wounds.*

A gun-shot wound strictly a contused wound, 3. Peculiarities, 3. Always painful, 4. Always bleeds at first, seldom afterwards, 5, 6. Mr. Wardrop in error on this point, 7. Secondary hæmorrhage never more frequent than four in a thousand, 8. Elasticity of an artery. Cases of Sir Lowry Cole, Sir E. Pakenham, Colonel Duckworth, 9. Constitutional alarm, 10. Continuance of it a dangerous symptom, 11. Case of Sir W. Myers, Sir R. Crawford, 12. Capt. James, Capt. Prevost, 13. Cases illustrative of the absence of this alarm. Soldier at Talavera, soldier at Castrojon, 14. Course of balls, 16. Necessity of having recourse to position illustrated, 17. Appearances of exit and of entrance of a ball, 18. When there is but one opening, 19. Staff-surgeon Lindsey's case, 19. Mr. Patterson's case, officer of the 40th regiment at Vimiera, 20. A ball sometimes causes a penetrating rather than a contused wound, 21. Case of Colonel Creagh, 93d regiment, at Vimiera, 22. Case of an officer of the 29th regiment, 23. Relaxation and resistance of parts, 23. Mr. Chevalier's opinions as to the course of a ball, 24. Commented on, 26. Author's opinion, 27, 28. On inflammation, good or ill success depends, 29. Mr. Hunter's opinions, 29. Arguments for and against, 32. Surgery not an art dependent on manual dexterity alone, 33. Author's opinions on inflammation, 34, 39. Case of Colonel Barns of the Royals, 40. Observations on peritoneal inflammation, 43. Extreme anxiety demonstrative of equal danger. Opinions of Dr. Dickson and Dr. Johnson, 47. Extreme anxiety a marked symptom of inflammation of the heart, 48. Opinion of Portal, 48. Case of Dr. James Forbes in point, 48. Estimate of the powers of the constitution explained by cases, 51. Marquis of Anglesea's case, 56. General

Turner, Capt. Macgennis, 57. The Guards generally, 57. Conclusions as to various kinds of constitutions, 59. Treatment of gun-shot wounds, 60. Error generally entertained as to the whole track of a wound sloughing, 61. Cold applications to be preferred, 62. Rollers not to be used on the field of battle, 63. Poultices in general the precursors of amputation, 64. Not used after the battle of Toulouse without a special reason being given, 64. Proper period for poultices, and return to cold applications, 65. Case of Sir R. Croft's son, 67. Cold not to be applied to the trunk, 68. History of appearances after the receipt of a wound, and treatment, 69. Friction, pressure, 72. Lodgment of extraneous matters, 72. Case of soldier at Badajos, of an officer, case by Dr. Chermside, 72. Mode of examination, 73. Ambrose Paré and Wiseman on incisions, 75. Baron Percy, 76. Mr. Hunter, 78. Mr. J. Bell, 81. Practice during the Peninsular war, 82. Opinions of Mr. John and Mr. Charles Bell commented upon, 83. The error explained, 85. Proper idea of scarification, 88. Dr. Hennen's opinions referred to, 88. Punctured wounds, 89. Balls ought to be removed from bones, 91. Sometimes not. Case of Lieut. Colonel Dumaresq, 91. Flexible tube, or Porteau's trocar, useful, 92. When extraction of balls is proper, and the reverse, 94. Sometimes difficult from membranous attachments, 94. Two cases in proof, of Staff-surgeon Lindsey and Assistant-surgeon Robson, 95. Of Colonel Ross, 95. A peculiar consequence of gun-shot wound. Case of Assistant-surgeon Curby, 29th regiment, of Surgeon Mahony, Royal Fusiliers, 96. Case by Mr. Knight, Inspector General, 97. Symptoms and mode of treatment, 98. Erysipelatous inflammation, 99. Opinions on, 100. Author's opinions, 101. Treatment of, 104. Erysipelas not common in gun-shot wounds, 104. On the Erysipelas phlegmonodes, 104. Mr. Hutchison's mode of treatment, 106. Author's opinion and cases, 106. Another peculiar consequence of gun-shot wounds, 111. Cases in suport of, 112, 113. Doubts as to the nature of this inflammation, 114. Mortification, 114. Different kinds of, 115. Author's opinions, 116. Division into local and constitutional, 116. Humid gangrene, 116. Amputation improper, 118. Dry gangrene, 120. Mr. Pott's and M. Quesnai's opinions, 120. Dr. Thomson and Dr. Woolaston, 121. Baron Larrey on traumatic gangrene, 122. Author's opinions, 125. On the nature and cause of an injury said to be inflicted by the wind of a cannon-ball, 127. Successful case of amputation during mortification by Deputy Inspector Campbell at Brussels, 129. Mortification from an injury of the principal artery, 132. Two errors pointed out, 133. The proper practice and period

for operating, 134, 135. The two states of humid and dry gangrene, present in the same individual at the same time, 137. Mr. S. Cooper's observations, 137. Mortification induced by typhus. Dr. C. Forbes, 138. From intense cold, 139. The effects not sufficiently considered, 140. Stimulant and sedative, 140. The barber, 141. Ludicrous scene in consequence of frost-bite, 141. Dr. Kellie's case, 142. Cases of Messrs. Paret and Martin, explained, 143. Maupertuis, 144. Effects of cold on Dr. Solander and Sir J. Banks, 144. Regulations for sentries in North America, 146. Opinions of Dr. Thomson, 146. Of Baron Larrey, that natives of warm climates bear cold best, 147. Opposed by occurrences at Ciudad Rodrigo and New Orleans, 147. In England by Mr. Burmester, 148. Effects of a moderate degree of cold, Elizabeth Woodcock, 148. Conclusions and questions of amputation, 149. Mode of treatment of frost-bitten parts, and successful case of amputation by Mr. Bruce of Ripon, during the spreading of mortification, 149. Gangrene from pressure, 150. Reports after the battle of Toulouse, confirmatory of all the preceding statements, 1, 2, 3, 4, 151. Hospitals in charge of Staff-surgeons Burmester, Dumoulin, Mathews, and Dease. The officers under Mr. Gunning, Surgeon-in-chief, and Staff-surgeon Murray, 152. Special report of Staff-surgeon Boutflower, now of Colchester, 156.

2. *On Gun-shot Wounds, accompanied by Lesion of the larger Nerves.*

Peculiar symptoms, 159. Accompanying lesion, a complete separation, 159. Power of resisting heat or cold destroyed, 160. Case of an officer at Salamanca, 161. Division of one of several nerves going to a part, 162. Case of a soldier at Albuhera, 162. Case of a soldier at the battle of Waterloo, 160. Of an officer of the rifle brigade at Waterloo, 163. Of an officer of cavalry at Waterloo, 163. Of an officer of infantry, 164. Case of a soldier at the battle of Vimiera, 164. Dr. Denmark's case of Henry Croft, wounded at Badajos, 165. Mr. Wardrop's case, 167. Sir E. Home's case, 169. Observations, 169. Dr. Hennen's case, 171. Case of an officer of light cavalry, 172. Case of a retired officer, 173. Case of an officer of rank, 173. Analogous symptoms from spontaneous affections, 175. Opinion of Professor Chaussier and of Richerand, 176. Mr. Pearson's case, 177. Mr. Crampton's opinions, 178. Mr. Abernethy and Dr. Monro, 180. Mr. Cruikshank's experiments on nerves, 181. Dr. Haighton's experiments, 181. Facts prove the regeneration of a nerve in animals, 182. Two different operations recommended to procure relief, 183. Amputation and excision, 183.

Opinions on both, 184. On injuries of nerves in bleeding, 185. Mr. Earle's case, 187. Means of mitigating pain, 187. Palliative cure, 188. On the temperature of animals, 188. Mr. Brodie, Sir E. Home, Dr. W. Philip, 189. Dr. W. Philip's conclusions, 189. Observations on, 190. Doubts as to the correctness, 191. Dr. Wilson Philip's explanation of them, 192. Case of a gentleman, who has lost only the power of resisting cold, 193. The evolution of heat supposed to depend on the integrity of a particular part of the brain, 198.

3. *On Injuries of the Extremities requiring the Operations of Amputation.*

Amputation formerly a very doubtful remedy, 199. Modern improvements have made its success more certain, 199. Opinions in favour of immediate operation, of Wiseman, 200. Of Le Dran and Ranby, 201. Of Bilguer as opposed to these, 202. Of the French academy of surgery. M. Faure and M. Le Comte against it, 205. M. Boucher in support, 206. M. Vandergracht, 207. Of Schmucker as opposed to Bilguer, 207. Mr. Alanson's improvements, 208. Opinions of Baron Percy, including those of La Martiniere, Moraud, Louis, Andouillé, Sabatier, and Dessault, 209. Of Mr. Hunter in detail, 210. Of M. Lombard, 212. Of Mr. John Bell, 213. Of Baron Larrey, 213. Practice of British army surgeons during the American revolutionary war, 214. In Holland and in Egypt, 214. Of the navy and army surgeons previously to 1815, 215. The operation sometimes performed at an improper period, 216. Cases at Ciudad Rodrigo and Salamanca, 216. Cases of an officer, and of two privates of the 27th regiment at Toulouse, operated upon by Staff-surgeon Lindsey, 218. Amputation after forty-eight hours have elapsed, done under different circumstances than at an earlier period, 220. Opinions of advocates for delaying amputation, 221. Not arising from practice, 222. Case of Colonel Turner, 223. Mr. Hunter on this point, 224. Opinions in opposition, 225. Statement of operations from June to December 1813, in the Peninsula, 227. Remarkable difference, 229. Mr. Gunning, Surgeon-in-chief, on the wounded at Orthez, 229. Mr. Mann on American surgery, 229. Division of amputation into primary and secondary, 230.

Of Primary Amputation.

The operation to be done as soon as posible, 231. Patient's state not being objectionable, 231. Soldiers anxious to undergo the operation, and to be supported after it, 232. Case of Sir James Douglas

in proof, 232. When it ought to be done forthwith, or without any delay, 233. Absence of pain a sign of great danger, 233. The bad consequences described by authors do not occur, 234. Accidents after primary amputation uncommon, 234. State of parts when amputation is delayed too long, 236. Treatment under these circumstances, 237. Bad state of the French wounded after the battle of Salamanca, 238. Reply to the observations of Mr. Hutchison, Dr. Quarrier, and Dr. Dewar, with cases, 239, 252. Conclusions on the subject of immediate amputation, 250.

Of Secondary Amputation.

To be performed after the third week, 252. Attended with considerable danger, 253. State of hospitals after a great battle, 254. Examples after the battles of Vittoria and the Pyrenees, 254. Endemic diseases and contagious fever affecting the wounded in Belgium and at Burgos, 255. A joint sometimes lost in consequence of delay, 255. Hæmorrhage sometimes a cause of secondary amputation at an unfavourable moment, 255. On inflammation attacking internal parts in an insidious manner, as a consequence of secondary amputation, 256. Generally attacks the lungs, and mostly proves fatal, 257. Cases in explanation by Dr. Irwin, Mr. Rose, Mr. Boutflower, 258. Abscess in the Liver, by M. Larrey, 259. Case by Dr. Chermside of abscess in the thyroid gland, 260. Case of Daniel Lynch after the battle of Toulouse, 261. This peculiar kind of attack not noticed by previous authors, 262. Author's opinion supported, 263. The claims of Mr. C. Bell refuted, 265. Case of John Hodges, of attack on the chest, 266. Of Michael Abernethy, of metastasis of matter, 268. Of John Lomax, attack on the chest, 271. Case by Dr. Higgins, Deputy Inspector of Hospitals, 272. Difference of type of fever, in Brussels and Antwerp, 272. Case of abscess in the liver, by Staff-surgeon Hughes, from Dr. Hennen, 273.

On the Operation of Amputation.

A great difference in the manner of performing primary and secondary operations, and in the manner of treatment, 273. Integuments not to be dissected back except in the leg, 274. And in some secondary operations, 275. Appearance of the stump when the bone is sawn through, 276. Mode of cutting the muscles, 276. Amputation to be performed higher up, if there be a sinus extending from the wound, 276. Mode of sawing the bone, 277. The periosteum not to be scraped off, 277. The bone to be divided perpendicularly, to prevent splintering, 278. Securing of arteries, 279. Tourniquet to

be removed as soon as possible, when used, 279. Ligatures to be cut long, or short, 281. Opinions of M. Delpech, Dr. Hennen, Mr. Haire, Dr. Fergusson, 282. Dr. Physick, Mr. Lawrence, 283. Fielding, 284. Stump not always to be united by the first intention, 284. Particularly when the parts are unsound, 285. Diseased state of the stump, often the cause of death, 286. On inflammation of the great veins, 287. Case of Clarke, 289. Inflammation of the veins after amputation, first noticed in this work, 292. Opinions of Mr. Hunter, Mr. Travers, 292. Mr. Carmichael, Mr. Hodgson, Mr. Wilson, 294. Case of Jane Strangemore, 296. Conclusions, 299. Dr. Davis's opinions, 300. Author's observations thereon, 300. Hæmorrhage in irritable and sloughing stumps, 302. recautions to be observed in tying the artery, 302. Case of popliteal artery by Mr. Berry and Dr. Robb, 303. The artery to be tied below the clavicle and not above, 304. On hæmorrhage from small vessels on the face of a stump, 304. On protrusion of the bone, 305. Use of stump caps, 307. Conclusion, and report on the state of the amputations at New Orleans, by Staff-surgeon Wasdell, 308.

On particular Operations.

Amputation always to be performed when a limb is torn away, 309. Differences of opinion, 309.

Of Amputation at the Hip-Joint.

Not noticed by modern authors, 310. Once performed in London unsuccessfully by Mr. Henry Thomson, 311. Mr. Pott's opinion against it, 312. Authorities but slender, 312. Of the Royal Academy of Surgery of France, 313. Messrs. Volher, Puthod, L'Alouette, Goursaud, and Moublet, 313. M. Barbet, 314. Case by M. La Croix, 314. Case by Dr. Kerr, 315. M. Larrey, his cases, 318. Of M. Baffos, 322. This operation either primary or secondary, 326. Nature of wounds requiring it, 327. Cases illustrative of, 327. Extensive injury of soft parts does not render it necessary, 328. Case of Capt. Flack, 88th regiment, in illustration, 330. Unsuccessful case of secondary operation at Ciudad Rodrigo, 331. Cases, 332. Dr. Emery's case, 334. Mr. Brownrigg's successful case, 342. Author's successful case, 342. Unsuccessful cases by Drs. Cole, Blicke, and Orton, 351. Particular states demanding the operation, 352. Not to be done by every body, 352. Mr. John Bell's opinion of the impossibility of suppressing the circulation in a large artery, shown to be erroneous, 352. Since abandoned, 354. Strong facts on this point at the York Hopital, 356. The surgeon must throw off

all dread of arterial bleeding, 357. Principal points of anatomy enumerated, 358. Method of operating by first amputating the limb, 359. Of Volher and Puthod, 360. Of Baron Larrey, 360. Remarks and objections to his method, 362. Author's method of proceeding, 363. Union to be attempted, 365. A posterior and dependent opening of great advantage, 365. Collections of matter to be guarded against, 365. The artery may be previously tied, 366. Amputation at the hip-joint established as a successful operation, 367. Ought not to be performed in cases of scrofulous affection of the joint, 367. The propriety of it questioned in cases of disease of the thigh bone, 368. Case, 368.

Of Amputation of the Thigh.

Nature of wounds requiring it from cannon-shot, 370. When the flap operation is advisable, 370. From fracture of the femur, 372. Where attended with the greatest danger, 374. General calculation of success in these cases, 375. After the battle of Toulouse in particular, 375. Has after other battles been in general less, 376. Amputation to be performed sometimes in doubtful cases, 377. More latitude to be granted to officers, 377. All compound fractures of the thigh to be placed in the straight position, 378. A positive order to this effect, given after the battle of Toulouse, 378. Wounds of the knee-joint, 378. Wounds of the femur exterior to the capsular ligament, not requiring amputation, 380. Treatment of wounds of the knee-joint, 381. Case of Colonel Donellan, 48th regiment, 382. Mode of performing amputation, two ways, 382. By the flap operation, 383. By the circular incision, 384. Compression of the artery against the os pubis, preferable to the tourniquet in certain cases, 384. Less blood lost than when the tourniquet is used, 385. Application of it, 385. Mode of performing the operation, 385. The fascia to be divided with the first incision of the integuments, 386. Union not to be attempted when the parts are unsound, 389. Mode of dressing, 390. On the different methods of dividing the muscles, 391. Opinions of Mr. S. Cooper, Alanson, Cheselden, Petit, Louis, &c. 391. Of Mr. Hey and Richter, 392. Of the author, 393. Of Loder, 395.

Amputation of the Leg.

Wounds from cannon-shot and shells, 396. From musket-balls, 397. When both bones are broken. Cases after the battle of Roliça, 398. Wounds of the ankle-joint, 398. Treatment of, 399. Amputation performed in two ways, 400. By the flap operation and by the circular incision, 400. The flap operation not practised in France, 401.

Not to be done on certain classes of patients, 401. On the operation by the circular incision, 401. Amputation may be done higher up than is usually recommended, 404. Advantages of it, and mode of doing it, 404. Case in point, 407. The flap operation unjustly discredited by the French surgeons, 407. Mr. Hey's method of doing it, 407. Remarks on its performance, 410. Another method, 410. Directions for wearing an artificial leg, 411.

Amputation of the Foot and Toes.

Wounds generally inflicted by musket-balls, 412. Tetanus a frequent consequence, 412. Require particular examination, 413. Metatarsal bones seldom require removal, 414. Of the great and little toe seldom necessary, 414. Amputation done to relieve tetanus, never successful, 414. Operation of removing the metatarsal bones and toes, 415. M. Chopart's operation at the tarsus, 416. Lisfranc's method, 417. Richerand's case, 418. Of a single bone, 418. Of the toes, 419.

Of Amputation at the Shoulder-joint.

The operation not to be done if it can be avoided, 420. Injuries from musket-balls considered, 421. From shells or cannon-shot, 425. Subsequent occurrences rendering amputation necessary, 427. Mode of performing the operation must be uncertain, 429. Principal points of anatomy enumerated, 429. The artery is never to be tied as a preliminary step, 432. The fear of hæmorrhage ought to be abandoned, 432. The common tourniquet the most convenient instrument for compressing the artery, 433. Proper place for applying it, 434. History of the first operation of the kind by Le Dran, 435. Garengeot, La Faye, 435. Sharp, Bromfield, 436. Alanson, 437. M. Larrey, 438. Mode of operating recommended, 439. Of the acromion process, 446. The removal of the coracoid process objected to, 447. The operation by forming the flap from the deltoid muscle, 448. Another, something in the same manner, 449. The glenoid cavity not to be scraped, 451. Two cases from Baron Larrey, 452. M. Dupuytren's two methods, 455. Messrs. Lisfranc and Champesme, their methods, 456. The Baron Larrey's detailed method, 461. Of the comparative success of the operation, 462. Cases, 462. Returns of this operation in the peninsula for six months, with a comparison of the success between primary and secondary amputations, 469. Mr. Gunning's report of the success of this operation after the siege of St. Sebastian, 469. Bromfield says it had always been unsuccessful in his time, 470. Its safety and simplicity established, 470.

Excision of the Head of the Humerus.

First noticed by Boucher, as to removal, 470. And practised by Mr. Thomas, 471. The excision, or sawing it off, by Mr. White of Manchester, 471. Case of Mr. Thomas, 471. Of Mr. White, 473. Of Moreau, jun. 474. Of the Baron Percy, 476. Of the Baron Larrey, 476. In the British Army, 480. Of Lieut. Madden and others, 480. Observations after the battle of Waterloo by Dr. Thomson, 482. Case of Assistant-surgeon Kennedy, 484. Opinion of the American surgeons, by Mr. Mann, 488. Four cases after the battle of Waterloo, 489. These prove that excision may be dispensed with, 489. The case of Thomas Ellard by Mr. Morel, 490. Critical remarks of Mr. C. Bell, 496. Method recommended of performing the operation, 497. State of parts explained in which a secondary operation of this nature is necessary, 499. Observations on Mr. Bell's critical remarks, with their refutation, 500. Conclusions on this subject, 505.

Of Amputation of the Arm.

Objections of M. Larrey to a high operation, 506. Considered to be erroneous, 507. Inconveniences occasioned by the tourniquet, 507. Case of hæmorrhage in an officer, 507. Mode of performing the flap operation high up, 508. Cases, 509. Case in which the subclavian artery was tied, by Messrs. Downing and Dease, 510. Of wounds of the arm as requiring amputation, 513. Mr. C. Bell's censure of army surgeons caused by an erroneous statement, 514. Case in proof, of Lieut. Colonel Hodge, 514. Of Sir Gregory Way, 515. Major Leahy, 516. Sir H. Vivian, 516. Consideration of wounds accompanied by fracture of the bone and division of the arteries, 516. Of wounds of the elbow-joint, 518. Case of Capt. Heyliger, 519. The operation by the circular incision, 520.

Excision of the Elbow-joint.

The observations of Messrs. Park, Moreau, and Jeffray, edited by the latter, recommended, 521. Cases requiring its performance, 521. Moreau's operation, 522. Dr. Jeffray's chain-saw, and mode of using it, and his opinion, 525. Mr. Crampton's successful case and opinion, 527. Of removal of the knee-joint, 531.

Amputation of the Fore-arm.

Seldom necessary as a primary operation, after wounds from musket-balls, 535. Of wounds of the fore-arm, 536. Two places of election

for the operation, 537. The opinion of M. Larrey considered to be erroneous, and his success attributed to his manner of dressing after the operation, 537. A long stump to be preferred, 539. Cases in support of this opinion, 539. The operation described, 540. Two other methods higher up, 541.

Amputation of the Metacarpus and Fingers.

Consideration of gun-shot wounds of the hand, 541. The metacarpal bones may be removed in two ways, 543. The saws proposed by different gentlemen, 544. The removal of the first phalanx of the thumb described, 545. Of the middle metacarpal bones, 546. Case in support, 546. The removal of the phalanx of the fingers at the joints described, 547.

APPENDIX.

Two cases in support of the opinions entertained at page 273.

ON

GUN-SHOT WOUNDS.

SOLUTIONS of continuity, caused by the collision of any solid substance, impelled by the force of gunpowder against the human body, are so denominated; and have been always supposed to possess some peculiar properties, which render them different from all other wounds. This opinion arose from the appearances accruing after an injury of this kind differing from those of any other; and as gun-shot wounds, in the surgical division of wounds into incised, contused, lacerated, &c. belong entirely to neither class, they should be considered as a separate one, depending for their general treatment on the common principles of surgery, but subject to many peculiarities. In referring to the general principles of surgery for an explanation of the phenomena of gun-shot wounds, I by no means wish to estimate so lightly as many authors have done, that knowledge in their treatment which is to be acquired by experience; for, although experience without principles would never lead to a thorough understanding, or the perfecting of any subject, yet a knowledge of principles alone, without that information which is to be acquired by practice, would, in this instance, of the two evils, be most detrimental to the generality of patients: for the received principles of any science may be found to be erroneous, whilst the laws of nature are immutable.

The nature of a gun-shot wound admits of much more difference than most wounds received in civil life from accidental causes; for the injury, as in many other cases, is not

only that of degree, but is differently modified, according to the part of the body injured, the size and shape of the offending cause, and the force with which it is impelled. The wound may, therefore, be at the same time incised, contused, lacerated, and penetrating; it may be a simple injury, as regarding the parts of the body injured; or complicated, or serious, when parts essential to life, or of consequence in the animal economy, are wounded; either as relating to the lesion of the functions they perform, or the constitutional symptoms that supervene from the injury.

To enable us to investigate these peculiarities with advantage, to adapt our practice to the leading characters of each injury, to proportion our measures to the urgency of the case, to abstain from interference where it is unnecessary or useless, and to act with energy where decision is required, it is advisable to treat of gun-shot wounds under different heads; and I have chosen the following classification, as sufficiently explicit and instructive.

1. On gun-shot wounds, or, of wounds in parts of no vital importance or comparative consequence in the human frame.

2. On gun-shot wounds accompanied by lesion of the larger nerves.

3. On gun-shot wounds, or injuries of the extremities, requiring the operations of amputation.

4. On gun-shot wounds accompanied by lesion of the larger arteries.

5. On gun-shot wounds affecting the head and neck.

6. ——————————————— thorax.

7. ——————————————— abdomen.

8. On gun-shot wounds accompanied by fracture of the bones.

I.

OF SIMPLE GUN-SHOT WOUNDS;

Or, of Wounds in Parts of no vital Importance or comparative Consequence in the Human Frame, and which in general require little Interference on the part of the Surgeon.

A wound made by a musket-ball is strictly a contused wound, and has therefore been supposed to partake, in a remarkable degree, of the immunity such wounds generally enjoy, of comparative freedom from pain and hæmorrhage; whilst the process of restoration, or filling up of the wound, has been equally presumed to be preceded by considerable suppuration, or of sloughing of the parts more immediately effected; being fundamental errors of principle, which have had a fatal influence on the practice resulting from them. For the degree of contusion is entirely dependent on the shape of the projectile, the force of impulsion, and the resistance opposed, which equally influence the symptoms and appearances resulting from the wound.

From the ideas usually attached to a contused wound, it has been supposed that gun-shot wounds are not painful at the moment of infliction. This, as a general principle, is erroneous, although in many the pain is but trifling, whilst in others it is severe, and, in some few rare instances, the patient has been unconscious of the injury. Allowing for the difference of sensibility in individuals, and the different manifestations of suffering made by them from the same apparent cause, it may be concluded, that, in soft parts, the pain felt is in an inverse ratio with the degree of contusion; we might perhaps say more justly, ought to be; for, in two persons suffering apparently from the same kind of injury, and with the same detriment, one will writhe with agony, whilst the other will smile with contempt. I have seen a sluggish phlegmatic individual actually dancing and screaming from a shot

through the thigh, whilst a very irritable man has only regretted it as an inconvenience. At the first battle which took place in Portugal, the 29th regiment, to which I was attached, had 200 men wounded in storming the heights above the village of Roliça, and most of these men were lying in a line of two hundred yards extent; they were all known to me by name as well as by person: the conflict was soon over, and the difference of expression in begging for assistance, or expressing their sense of suffering, will never be obliterated from my memory; and it would have been a lesson to those who deny that pain and constitutional alarm are attendant on gun-shot wounds, which they would never have forgotten. From a mistaken sense of duty I marched with the regiment towards the enemy, who reserved their fire until the troops actually met, and I saw and *heard* the first gun-shot wound received from an enemy, that I ever dressed. It was on the shoulder, and the soldier described it as a severe numbing blow, depriving him momentarily of the use of his arm, and followed by a severer pain. Whilst correcting this sheet for the press, an officer has called upon me who was wounded by a cannon-shot, on the fore part of the thigh, at the siege of Badajos; and he describes his sensations at the time as being a confused sense of a severe injury, followed immediately by great pain in the part affected. Shortly after the battle of Vimiera, I was wounded myself in the legs by a musket-ball, which fortunately only grazed one and bruised the other; yet it would be difficult to convince me that I did not suffer great pain from the injury. During the battle of Vimiera, I was examining a wound in the arm of a soldier, when he received another ball in the nates, the pain of which made him spring from the earth, and induced us both to seek for shelter. That pain is a general attendant on gun-shot wounds I think I may be permitted to declare with confidence; that it varies in intensity I have admitted, and that in some very rare instances it is not experienced, cannot be disputed; for, on several occasions, I have had applications for assistance on account of one wound, and

have perceived from the bleeding that another had been received, of which the soldier was unconscious. But this never takes place when an organ of importance is injured, and is a circumstance by no means peculiar to gun-shot wounds; for when two men, or even children, are wrestling or fighting, many injuries are sustained which usually cause much pain, but which at the moment are not felt; and in battle, when the ball is impelled with great force from an unexpected quarter, whilst the soldier is anxiously engaged in another, he may be wounded without being immediately sensible of it. I am induced then to conclude from many considerations, that the greater the velocity with which the projectile is impelled, the rounder and smaller the size, and the less the resistance opposed, the less will be the sensation of pain produced in the sufferer. But even this opinion must be received with considerable latitude, for man admits not of mathematical precision; and a cannon-ball will sometimes completely destroy the internal texture and life of a part, without tearing the skin or causing much pain, and yet the shot causing such injury have usually lost the greater part of the velocity with which it was originally propelled. A musket-ball, merely impinging against a soft part, without rupturing the skin, invariably causes much more immediate pain, and for several days much more inability, than if it had actually entered, or passed through it. Major King of the Fusileers was killed at New Orleans by a musket-ball, which struck him on the pit of the stomach, leaving only the appearance of a contusion, apparently in the same manner as a blow from the hand of a pugilist on the same part.

The subject of pain is, however, of trifling import, when compared with that of hæmorrhage; it is merely a matter for discussion, whilst bleeding must be one of great anxiety, and may be the cause for necessary or unnecessary action. The erroneous idea, which has pervaded alike medical books and the minds of medical men, that gun-shot wounds do not bleed unless great arteries are wounded, has arisen from generalizing too much, when the authors have not been actors in the scenes

they describe; or from their first laying down a supposititious foundation, and then rearing on it a superstructure, such as it ought to be according to theory, without encumbering themselves as to the fact. According to theory, a gun-shot wound, being a contused wound, ought not to bleed, in the first instance, because the parts are dead or deadened; and if it should bleed, some great blood-vessel must be injured; whilst, according to the same authority, secondary hæmorrhage was to be expected and dreaded at the moment of the separation of the sloughs. Hence have I seen a surgeon on the field of battle, groaning under the weight and inconvenience of a sack full of tourniquets, not one of which he would, in all probability, have a proper opportunity of applying, and tormenting himself for days after the action, in the expectation of secondary hæmorrhages, which never took place. Facts are often opposed to theory, and in nothing more than on this point; for although some gun-shot wounds bleed but little at the moment of infliction, there is, in the greater number, more or less loss of blood, and occasionally in considerable quantity, although there be no vessels of importance injured. In wounds of the face and neck, the quantity lost is often considerable, and the clothes are generally covered with it. If the ball inflicting the injury should have come in contact with any solid substance, previously to its touching the human body, it may have become of an angular, irregular, and even flattened form; the wound will be, in consequence of this change in the ball, more lacerated than contused, and the loss of blood, in all probability, greater. The colour of the blood will be arterial, but a wound of a large artery is not to be feared, unless it be emitted in great quantity, and per saltum, and continues to be poured out of a bright colour and without intermission, in spite of the common pressure, or means made use of for its suppression; in which case the lesion of an artery of some magnitude is indicated. The bleeding from a simple flesh wound soon ceases, and does not return, except some violence be done to the part; whilst in a case of wounded

artery, it sometimes continues until the patient dies, which is frequently the case when a large artery is partially divided. If the artery be completely divided, a considerable quantity of blood is quickly lost, and the patient may also die; but in general, syncope, or a state nearly allied to it, supervenes, and the hæmorrhage ceases spontaneously. The same thing takes place when a limb is carried away by a cannon-shot, and proves the safeguard of the patient's life; for serious and destructive bleeding has ceased in most cases before a tourniquet can be applied; and indeed in the greater number of cases they are of no use whatever; for after the hæmorrhage has been once spontaneously suppressed, it does not in general return; and whenever it does return, the patient's life will certainly be lost, unless proper and effective assistance be at hand*. I am here stating general rules, and not noticing

* Mr. Wardrop, in an interesting paper inserted in the tenth volume of the Transactions of the Medical and Chirurgical Society, entitled, "Some Observations on a Mode of performing Operations on irritable Patients, in which bleeding to Syncope is recommended, in order to overcome the Irritability and Sensibility for the Time required," considers the loss of blood as otherwise advantageous, because he had almost universally observed, that those patients recovered from operations best who lost the greatest quantity of blood; "a fact," he says, "strikingly illustrated after the battle of Waterloo, when it was found, that the wounded who were left in the field, and not taken into hospitals till the fourth and fifth day after the battle, recovered much sooner than those who were immediately attended to. This difference could only be accounted for, by the bleeding from the wounds being so extensive as to produce syncope; thus preventing inflammation and fever." The fact I do not object to, but the inference is, I think, incorrect, being incompatible with the statement made above. The loss of blood, which occurred in these persons, took place only at the moment of injury, and was in the same proportion as in those cases which were carried into the towns, and improperly fed and treated. If a second bleeding had taken place from a wounded artery, the patient's life must have been lost, unless a proper operation was performed, as will be further shown in the chapter on Wounded Arteries. The real truth is, that the patients thus exposed were nearly all suffering from fracture of the lower extremities, which prevented their being

exceptions; for when a large artery is only partially divided, the application of a tourniquet, or the production of the effect of it by any other means, will alone prevent a fatal termination, which actually did happen in three cases which have come to my knowledge, in one of which the femoral, in the other the humeral, and in the third the carotid artery was wounded. In the same manner the application of a tourniquet, or of pressure, may save a few ounces of blood in some particular instances, and consequently the life of a valuable man; but in general it is not the tourniquet which suppresses the hæmorrhage and saves the life of the patient, but the spontaneous efforts of nature alone.

It may be received as a general rule, although admitting of exceptions, that a hæmorrhage thus spontaneously repressed will not recur, unless from impropriety of conduct, or accidental violence; neither will a due degree of suppuration or sloughing in the wound effect it. The chance of secondary hæmorrhage is but trifling; and if in such cases as these it is so, there can be no doubt but that it must be next to nothing in others where no vessel of importance has been injured. On the separation of the sloughs, a little blood may occasionally be lost, but it is generally caused by the impatience of the surgeon, or the irregularity of the patient, and seldom requires attention. Sometimes at this period, that is, from the eighth to the twentieth day, a large artery will give way from sloughing or ulceration; but the proportion of cases requiring the ligature of arteries will not be greater than three or four in a thousand taken indiscriminately, exclusive of hæmorrhage caused by hospital gangrene, inordinate slough-

removed, until the means of transport were plentiful; and these unfortunate men were not benefited by the exposurse, although they indubitably were by the starvation they underwent. The want of food has never been found injurious after any great battle, inasmuch as abstinence is an excellent mode of preventing inflammation; but it is not consonant to common sense to suppose, that proper surgical care is not more serviceable than neglect.

ing, or broken bones, which are not the usual causes hitherto alluded to as inducing secondary hæmorrhage; and which, as they may almost always be avoided by proper care and management, cannot with propriety be considered as legitimate causes.

It is not intended to deny that hæmorrhage does occasionally take place from wounded arteries, which cannot be controlled in time, or which requires the tourniquet; but it is not common, and seldom occurs unless a large vessel is divided near the heart, or is only partially divided and cannot retract, when the patient will continue to bleed until he dies*. An artery, when not hit direct, more commonly recedes from the ball by its elasticity, and its coats only are injured without any hæmorrhage immediately taking place, although the parts injured may subsequently slough; but this does not necessarily follow, for in some instances, when all the coats are affected, they inflame, and the canal of the vessel becomes obstructed, of which I have a preparation, where a ball passed between the femoral artery and vein without dividing either; and in others, I have reason to believe, the vessel completely recovers itself. It is by reason of its elasticity that the subclavian artery so often escapes when the ball appears to have passed directly through its usual track. Sir Lowry Cole, who was wounded at Salamanca, and a piece of whose rib subsequently exfoliated, is a good instance of this kind of injury; and the late Sir E. Pakenham was twice wounded in the neck in the same manner, the ball crossing each time from side to side across the line of the great vessels, without injuring either. His last unfortunate wound was more direct, being through the common iliac artery, and killed him on the spot.

The distinctions then usually made, that gun-shot wounds do not bleed at the moment of injury, unless a large artery

* Colonel Duckworth, of the 48th regiment, at the battle of Albuhera, received a ball immediately through the edge of the leather stock, which divided the carotid artery, and killed him before assistance could be procured.

be wounded; and that they do generally bleed, and often profusely, after suppuration has taken place; cannot be too soon banished from the mind of every surgeon, as they lead to very bad practice, and give much unnecessary trouble: for instead of waiting with the greatest anxiety for hæmorrhages, when the sloughs separate from wounds in the vicinity of great arteries, the surgeon may think himself peculiarly unfortunate, if he meet with a greater proportion of cases than I have mentioned.

When an organ of importance has been injured, and the blow severe, as by a cannon or grape shot, or shell, or from the fracture of a bone, and even from the attention being directed to the receipt of an injury from the situation in which the soldier may be placed, a peculiar constitutional alarm ensues in a much greater degree than would follow an injury of equal magnitude, precisely in the same spot, from any other cause. It affects alike, although not in an equal manner, the coward and the brave, the man of learning and the unlettered soldier. As it is, however, an affection often greatly augmented from an association of ideas, so is it more immediately controlled by men of sound judgment, or command of mind, and is more certainly removed by the knowledge of the injury being of little consequence.

On the receipt of a wound which has the appearance of being fatal, or if circumstances of situation can give rise to such an idea in the patient's mind, the constitutional affection is often as manifest at first as when some vital organ has been injured; but it subsides much sooner, and offers us in doubtful cases a diagnostic symptom of the greatest value and certainty. When Marshal Soult was driven out of Oporto in 1809, that part of the army to which I belonged seized on some boats, and crossed the Douro very unexpectedly into the heart of the town. The 29th regiment, which first landed, immediately pushed through the town to seize upon a ridge above it; the confusion was great, the French had not expected it, and had not abandoned the town: the troops, the

baggage, sick, &c. fled in all directions, and the inhabitants began to take summary vengeance on the stragglers. The 29th advanced rapidly on the French army, which, finding itself turned, immediately retreated in confusion. At this moment one of the skirmishers suddenly came upon his adversary, in consequence of the rapidity of the advance, with only a small bank between them; both parties presented, the muzzle of the pieces nearly touching, both fired, and both fell. The British soldier, after a minute or two, thinking himself hit, but still finding himself capable of moving, got up, and found his adversary dead on the other side of the bank. I saw him immediately afterwards in considerable alarm, being conscious of a blow somewhere, but which on diligent search proved to be only a graze from a ball on the ulnar side of the arm; yet the certainty he was in of being killed, from the respective positions of the parties, had such an effect upon him at the moment of receiving this trifling injury, as nearly to deprive him for a short time of his powers of volition: whereas, if the wound had been received from a concealed or distant enemy, it would in all probability have been little noticed; there would have been no impression on the mind of the unavoidable and impending danger, and little or no consequent alarm.

The continuance of the constitutional alarm, or shock, ought to excite great suspicion of serious injury; and when wounds have been received in such situations, or bear such appearances as render it doubtful whether any parts of vital importance have been injured or not, the surgeon may sometimes make up his mind as to the fact from it alone, when other symptoms more indicative of the injury are wanting; and, under all such circumstances, he ought to be particularly guarded in the prognosis or opinion given to the patient or his friends, although every other appearance should even lead him to suppose the injury to be less serious.

The late Sir William Myers was struck by a musket ball,

at the battle of Albuhera, on the outside of the right thigh, which broke the bone without appearing to splinter it to any extent. I directed him to be conveyed to the village of Valverde, and was led to hope, from the appearance of the wound, for a favourable result; seven hours after the accident I found him very restless, exceedingly anxious, and the countenance indicating something more than a compound fracture of the thigh. On questioning him, he complained of pain in the belly, and I immediately suspected that the ball had slanted off (for he was struck on horseback, with the thigh bent), and had passed upwards into the pelvis. The increasing symptoms of inflammation of the abdominal viscera confirmed my suspicion, and in spite of bleeding, and all the care I could bestow, he died early in the morning with the greatest calmness. When I informed him that he had but an hour or two to live, he pressed my hand, and said, "My good friend, how many envied me this morning going into action in command of the fusileer brigade! how few will envy me now!" He made me promise that he should not be opened, and I know not the exact course of the ball: it may perhaps have passed through the thyroid foramen.

Major General Sir Robert Crawford was wounded, at the foot of the lesser breach at the storming of Ciudad Rodrigo, by a musket-ball, which entered the outer and back part of the shoulder, through the posterior fold of the armpit, and came out at the axilla. I saw him immediately afterwards with Dr. Robb, who pointed out a third wound apparently too small for the entrance of a ball, and resembling a slit. We at first hoped, that this had not been made by the same ball, especially as the thoracic symptoms were not urgent; but the continuance of the uneasiness, and the augmentation of the symptoms, soon convinced Dr. Robb of the extent of the injury; and after death the ball was found rolling about on the diaphragm, having just had sufficient force to penetrate between two of the ribs, but without injuring the lungs.

During the successful assault on Badajos, Captain James, Deputy Assistant Adjutant General, was brought to me, having been wounded severely on the nates and back part of the thighs, at the foot of the breach, whilst giving directions to the troops. There were four openings, two apparently corresponding with the other two, as the entrances and the exit of two balls; and as he was so close to the enemy at the moment of injury, it was conceived the balls might readily have passed out. Some time however had elapsed, and the general alarm and distress having but little subsided, the sensation at the præcordia being oppressive, and the general feeling of derangement great, I suspected, and was almost convinced, that the openings did not correspond, although their external appearances and direction would admit of the supposition, and that there were three balls at least, one of which must have penetrated into the cavity of the abdomen. The rising inflammation proved this opinion to be correct, and this gallant officer died on the twelfth day, not from inflammation, for that had been subdued, but from hæmorrhage per anum, in consequence of the separation of the sloughs from some internal vessel.

On the retreat of the British army from Fuente Guinaldo, in 1812, Captain Prevôst, aide de camp to Sir Edward Pakenham, was wounded in the left side by a ball which passed out at the right hypochondrium. From the slanting direction and small size of the ball, it could not readily be followed by the finger into either cavity; and from its appearance, the surgeons, who first saw him, were in hopes that it had not penetrated the chest. The anxiety I have alluded to remained, and rather increased; and from that circumstance alone I pronounced an hour afterwards, that the wound was of a very serious nature. I discovered, on dissection, that the ball had injured the left lung, the diaphragm, and the liver*.

* From the examination of this and other cases, which recovered from the immediate injury, I am induced to believe, that wounds of the

That this constitutional alarm and derangement is not always present to so marked an extent, I most willingly admit, and that the proper, and what might be considered even necessary and characteristic symptoms attendant on an injury of the most sensible and highly organized parts are also sometimes wanting, the following case will show.

During the battle of Talavera I was shifting my situation to avoid the ricochet shot of a twelve-gun battery, stationed immediately in front of the place I had chosen for my wounded, after the assaults of the preceding night: when I saw a man running after me waving his hand, and calling out to me to stop, which I did, and was rather impatient on finding that he wanted me to examine his head, on which he protested that one of the round shot I saw plunging around us had just alighted; and pulling off his cap, which bore the mark of the injury, he showed me to my astonishment, that not only was the skull driven in, but a portion of the brains and mashed bone intermingled with the hair. I sent him to the rear, and never saw him afterwards, although I searched for him in the different hospitals*.

diaphragm (in consequence of the motion of the part) never unite, but always leave an opening with rounded edges, through which herniæ of the stomach or intestines are apt to be formed, and sometimes become strangulated.

* The plunging of shot, technically denominated ricochet, is a pleasing, although awful and deceitful sight, the ball appearing to bound like a cricket-ball; and we are only led to estimate its force by the manner in which it ploughs up the ground. At the affair of Castrojon, previous to the great battle of Salamanca, a poor Irish lad of the 27th regiment was silly enough to call out to his comrades, on seeing a shot of this kind, "Stop it, boys;" and to endeavour to do so with his foot, which was smashed to pieces, so as to render amputation necessary. The oddity or naïveté of these fellows, who obtained the name of the "Babes," was further exemplified on the same day by another of them at a very critical moment. The troops had been marching from three in the morning until long after mid-day, under a burning sun, which killed several in the ranks, especially Portuguese, and the whole were greatly exhausted. At this moment the French, after a severe can-

The infliction of a gun-shot wound of any importance is then generally followed by more or less loss of blood, of pain, which is occasionally acute, and by a peculiar anxiety, alarm, and loss of animal and organic powers, that are in a great measure characteristic of this kind of injury. The patient, if the injury be great, is often unable to stand without support, his muscles are not subservient to the will, a deadly paleness overspreads the countenance, a tremor pervades the body, big drops of sweat bedew the forehead, the heart almost ceases to act, and if a great artery be divided, the patient's life is only saved in consequence of this diminished energy, or even by a complete state of syncope.

On the receipt of a simple gun-shot wound the patient is in general brought to the surgeon, slightly hurried and alarmed, with some little loss of motion and power in the part, which bleeds, or perhaps only oozes, or if it be some time done, it is stiff, dry, and painful. If the ball should have passed through the part with great velocity, the sensibility will be much destroyed, there will be little pain, but

nonade, attacked the left of the British army; and Sir Lowry Cole, who commanded, in order to put an end to the affair, charged them with the 27th and 40th regiments and some squadrons of cavalry. The troops, harassed to the last, moved very slowly, the French stood firm; and when the parties had nearly closed, and it was doubtful which would turn (for one party or other always runs), the French broke, and left us the field of contest. But at the critical moment, and when one half minute more would have crossed their bayonets, one of the Babes, seeing a large stone, stooped down, and threw it into the French square, with the characteristic exclamation of "Hurrah, my boys!"

On the subject of charging with the bayonet there is great misapprehension: the parties never actually meet, and struggle foot to foot, and hand to hand; on the contrary, one side runs away as soon as the other comes close enough to do mischief. This is, and has invariably been the case with the British, when regiments or large bodies of men have met: small bodies of men may have personal conflicts, but almost all those who are wounded by bayonets will be found to have received their wounds after the affair had been decided, or rather in the subsequent scuffle.

this will be increased as the wound approaches more to a laceration of parts; and it will be most severe at the moment of the injury, and for some time afterwards, if the injury should amount only to a contusion or bruise, without any division of the skin.

As an injury of this kind is always caused by the impulsion of some foreign body with violence, which will in general have carried with it some part of the clothing, or other extraneous substance, it is of consequence to ascertain if the ball have passed out; and it is not always possible to decide which is the entrance or the exit of the ball; or, when the openings are distant, whether they are caused by the same, or two distinct balls. To ascertain this, the patient ought to be placed in the position he was in on receiving the injury, and with reference to the probable situation of the enemy, when the nature of the wound will be more clear. Suppose a soldier to have a wound on the outside of the knee, and another near the hip, if it be ascertained that he was stepping forwards at the time, and the enemy much above, or a little below him, the course of the ball will be satisfactorily accounted for; and if the opening near the knee be round and a little depressed, whilst the other is a little torn, or is merely a small slit, the entrance and the exit of the ball will be clearly marked. If, however, both openings are rounded, depressed, and the finger can with care be introduced a little way, there is great probability of there being two distinct wounds. If there should be but one injury, the course of the ball can seldom be followed, it may have passed above or below the fascia, but in neither case will there, at the moment, be any mode of distinguishing the track it has taken: if it be below the fascia, the inflammation will of course be considerable; if in the cellular membrane, there will then be more of laceration than contusion, and the parts will unite in great measure by the adhesive inflammation. In many cases the track of the ball will be marked by a black line along the skin immediately over it, indicating

a greater degree of jar and contusion, but not necessarily terminating in suppuration, nor requiring an opening to be made for the discharge of matter.

The absolute necessity for placing the patient in the same situation or position he was in at the moment of injury, has been insisted upon by the most ancient authors; and it is said, that one of them was so scrupulous on this point, as to cause a soldier, who had been brought to him wounded, to be replaced on his horse, that he might more readily estimate the various parts which had been injured. After the battle of Toulouse, my attention was directed to a soldier who was said to have received a slight wound in the thigh, but whose foot had sphacelated without any apparent cause. I instantly declared that the femoral artery had been injured, but the attendant surgeon replied, that the wound was not in the immediate course of the vessel. On desiring the man to bring his limb into the same position in regard to us, that he supposed himself to be in towards the enemy when he was wounded, the possibility of such an occurrence was demonstrated, and subsequent dissection proved the correctness of the opinion. After the battle of Pampeluna, much surprise was excited by the femoral artery having escaped injury from a wound which appeared to pass directly through it; but on putting the patient in the same manner in position, it was evident that the ball might readily have passed at some little distance to the outside of it. At the battle of Talavera a soldier received a ball on the outside of the ankle, a corresponding opening appearing at the trochanter; the course of the ball seemed inexplicable, until the man related that he was running, and had his foot raised at the moment of injury.

The wound made by the entrance of the ball is generally different from that made by its exit. The most marked peculiarity attending the entrance is a circular depression, capable of admitting the little finger*, and of a livid colour; whilst

* The French balls are smaller than those used in the British army.

the exit is more ragged, not depressed, sometimes little more than a slit or rent, although at others it may be much torn. But these appearances are by no means constant, or so strongly marked. If the ball impinge with violence against a surface capable of offering considerable resistance, the entrance will be well marked. If the resistance offered be nearly equal to the momentum, the ball will lodge, or pass through with a well-marked exit; but if the velocity and impulse be greatly superior to the resistance, the exit, although not a depression, will often partake in the appearances of the entrance; the velocity with which the ball passes through the part overcoming so instantaneously the resistance, that the laceration, which would otherwise take place in the passage of the ball from the dense medium of the body to the rarer one of the air, does not occur. When a ball is moving with little impulse, the entrance is by no means so well marked. The natural or different connections of a part of the same structure often influence the appearances of the wound, as may be exemplified by comparing the state of the skin at the exit of a ball in the back of the thigh, and the back of the hand. In the thigh there may be only a hole, partaking of the nature of a slit; but on the back of the hand, the whole skin may be torn up, so as to make a frightful-looking wound of what is in reality not so. At the battle of Salamanca I was requested by a young assistant to give my opinion, whether amputation should be performed or not, in a case in which a musket-ball had destroyed the metacarpal bones of the little and ring finger, and torn the skin from off the whole of the back of the hand, leaving it in rags, and of a frightful appearance. I desired the fingers to be removed, the pieces of skin to be brought back to their respective places, and made to cover in the surgical wound; which was readily accomplished, and a useful part of a hand preserved.

When the wound is caused by a piece of a shell, a flattened and irregular-shaped ball, or other sharp-edged instrument of destruction, it is very much of a mixed nature,

between contusion and laceration, and the entrance of the ball is more indistinctly marked. This lacerated state is frequently seen in wounds from pieces of shells, and portions of integuments are often torn up, which may be laid down with advantage, and union fairly expected; and if this should not take place immediately, it may in general be effected in a short time afterwards, with little suppuration or loss of parts.

If there be but one opening to be seen, it is usual to suppose the ball has lodged; but this does not always follow, although the finger may pass into the wound for some distance; and a want of knowledge of the possibility of such an occurrence has often given rise to much unnecessary examination and anxiety. It sometimes happens in injuries of the head, that the ball drives a piece of bone nearly of its own size into the substance of the brain, although it does not actually penetrate with it, but falls to the ground. A ball will often be turned, as is well known, by a slight resistance, which is not directly opposed to it; but if the resistance be greater than the momentum, and offered by an elastic body, the ball may retrace the passage it has made; as, for instance, when opposed by the cartilages of the ribs, or any strong tendon. An officer, at the battle of Toulouse, received a slanting shot on the left side of the chest; the ball entered, passed under the skin, injured the pectoral muscle, but was stopped and ejected by the cartilages of the ribs, before it reached the sternum. The finger could follow the track, and the absence of all symptoms indicating lodgment, or further injury, proved the ejectment of the ball.

After the battle of Waterloo my opinion was requested on the case of a very young officer of the rifle corps, who has since entered the Church, who was struck, as was supposed, by a canister-shot on the knee, which had lodged in the head of the tibia, although it could not be felt. I examined the joint, found a large external opening with the bone broken within, as if a ball had entered deep into its substance; the

whole joint was in a state of suppuration, the pulse 130, and he was much emaciated. Amputation was performed with great dexterity and dispatch by Staff-surgeon Lindsey, and the patient's life was only saved by this gentleman's unwearied diligence. I examined the joint, after the operation, but no ball could be found; it had never lodged.

Sometimes the clothes of the individual will not be torn by the ball, and are carried in with it for the space of half an inch, or even more (Mr. Patterson, of the 25th dragoons, informs me he has seen this happen in India, a part of the leather breeches going into the wound like a purse). It is not, however, so easy to account for a ball carrying in a part of the shirt, or of a silk handkerchief, for the distance of three or four inches, without the linen or silk sustaining any injury.

At the battle of Vimiera an officer of the 40th regiment, while under the fire of the enemy, requested me to look at a wound he had the instant before received in the thigh. I saw that the shirt had gone in with the ball, and on pulling at the shirt, it came out from the depth of four inches, a perfect *cul de sac*, having the ball at the bottom of it. Ambrose Paré relates a case precisely of the same kind, but with a view of proving, what in his time was of some consequence, that balls do not burn. The clothes of the patient should then always be examined, not only to ascertain the fact, but to enable us to discover what part of them may be carried in with the ball.

If the ball has passed directly through a solid part, it will generally carry out with it any portion of the clothes of the sufferer, or other foreign substance which it may have driven in before it; and if the part, after being placed in position, admits of easy examination by the finger, or by the probe, it may be made for the sake of satisfaction. But as balls often lodge, it is absolutely necessary to ascertain, if possible, their situation. They will frequently be found on the opposite side of the limb, near, or immediately below

the skin, the elasticity of which has resisted and overcome the momentum of the ball; and in many instances when the skin has yielded, a flannel shirt, or the red coat, has stopped its further progress. When the force with which the ball is impelled is not great, or is nearly exhausted, it is often stopped by the bones against which it strikes, without fracturing them, or even doing any sensible injury. A ball, after impinging against the soft parts of the body, is always flattened to a certain degree on one side, or loses its globular form; but when it strikes against and is stopped by bone, it is distinctly flattened by it. A ball will often pass into or through a bone, and be afterwards stopped by the periosteum, a ligament, or the skin. In the three first instances the ball is lost or hidden from our researches, and is only discovered by the subsequent results. A ball may also lodge in the tibia or femur, without fracturing them. I have related the case of one in the chapter on Wounded Arteries, which passed through the femur, above the condyles, into the knee joint, splitting it upwards in its axis, without impairing its powers of support.

When the ball is not passing with great force, it may become a penetrating without being much of a contused wound; it will apparently drop into the limb, without destroying the parts around it, which close in with little suppuration or slough; a great part of the wound will appear to unite by adhesive inflammation; and if the ball do not press upon some important nerve, or impede the action of a muscle or muscles, either by its position, or the adhesive inflammation which ensues and forms the sac that surrounds it, it may remain quiet for life. I have seen many of these cases, where the injury committed and the symptoms which ensued were trifling; and I have seen, on the other hand, where the symptoms of inflammation and suppuration were of little import, that permanent lameness followed.

Lieutenant-colonel Creagh, of the 93d regiment, received a wound of this kind at the battle of Vimiera; the

ball entered at the upper and outer part of the front of the leg, passed downwards and backwards under the soleus muscle, and could neither be felt nor followed at the time. Under the application of cold water, little inflammation ensued, and only a trifling suppuration followed; no slough was discharged, and the wound healed. He has never since been able to get the heel to the ground; the ball has formed a sac for itself immediately over the flexor muscles, whose motion it impedes, and it is now, after a lapse of twelve years, to be distinctly felt. I could not, however, promise there was no risk in removing it, neither did I press the operation; and my friend prefers putting off the evil day, although it has once or twice placed his life in extreme danger, by forcing him to ride into action under circumstances of particular exposure.

In severe wounds, where a ball passes deep through muscular parts, or slightly injures the bone, it is in general more of a contused wound, and a variety of circumstances and actions must take place before a cure can be accomplished; but it does not appear to me that they have been duly estimated, and especially those that immediately ensue.

The two great points of difference usually attributed to a gun-shot wound, the absence of hæmorrhage and pain, are too much exaggerated, as I have already noticed; for there are few wounds of this kind which do not bleed and are not painful, sometimes indeed extremely painful, from the instant of infliction, not only in the part injured, but often in a more distant one, as in the thumb and fore finger, when the outside of the arm has been wounded; the little and ring finger, when, on the contrary, the inner side has suffered; or in the sole of the foot, when the back part of the thigh has been wounded; and, indeed, in the finger and arm, when a ball has passed through the neck. But this is not truly the pain that is alluded to; it arises from a large nerve being injured, and referring its sensations to the part on which it

is distributed; but it is a pain the surgeon must particularly attend to, as indicating the principal mischief, when, from the appearance of the wound, little injury might be suspected. Pain then often becomes of great consequence, as, in addition to position and other circumstances, it enables us to judge more accurately of the parts that may have been injured, and of the course of the ball.

An officer of the 29th regiment was wounded at the battle of Talavera by a musket-ball, on the fore part of the right thigh, which made its exit through the left nates. It wounded the great femoral vein, passed upwards and inwards into the perinæum in front of the urethra, without injuring it, although matter afterwards formed at that part, and was evacuated. This gentleman, after some time, perfectly recovered, but all the superficial veins of the wounded thigh have greatly enlarged, almost appearing varicose, and communicate with the superficial veins of the abdomen, which are also of increased dimensions, forming a beautiful venous anastomosis, that is very remarkable when compared with the other side. It would be difficult to make out the cause of the peculiar direction this ball took, from any data we are acquainted with. Knowing, as we now do, the results, an approximation might be made to it, but that embraces considerations perfectly unknown at the moment of injury.

From what has been said, it will be understood, that position even must not be too scrupulously observed in making an examination; for, although the passage of a ball through even a distant course is sudden, the spasmodic action of parts is more so. And I can conceive, although the muscles of a limb may be at the moment of injury in a state of moderate contraction or relaxation, that several of them may be in a very different state whilst the ball is actually passing through them: add to this the difference of resistance of many parts, and of the same parts under different circumstances, and the necessity for deviations from the supposed

position at the period of injury will be evident, in order to enable us to find balls that are hidden. I am occasionally consulted by two gentlemen having balls within the knee-joint, which can only be felt when the limb is in a state of flexion, although the injury was inflicted when it was in a state of extension. Whilst, then, position is to be attended to with strictness in the first instance, due attention to the action of the different parts must not be neglected. The various degrees of resistance of each part may be speculated upon; and, if no symptoms supervene, such as pain, hæmorrhage, loss of particular function, which may be called positive symptoms, the surgeon may form a conjecture as to the probable course of the ball, and examine accordingly.

In all such examinations, whether in the exact course of a ball or at a distant part, the surgeon should never forget to make a counter-pressure to the fingers with which he is searching for the ball. This is most essential in the extremities, where counter-pressure will often bring an extraneous body within the reach of the finger or probe, which otherwise would not have been attainable; and the pain which is often excited in a particular part by this pressure, is an additional indication of the track or situation of the ball.

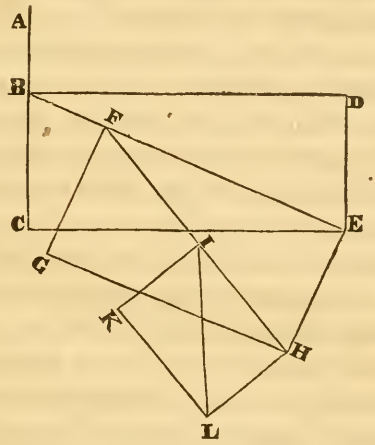
Mr. Chevalier*, page 51 of his very interesting work on Gun-shot Wounds, has accounted for the injury caused by

* The less of the original impulse is left in a shot still moving, the more liable will it be to be stopped or turned out of its course by any given resistance.

Every new resistance, which a shot in motion meets with, will operate so as to produce not only a diminution of its momentum, but also a change in its direction; every fresh resistance being in fact equivalent to a fresh power, acting in a different line to that in which the shot was previously moving. As a body acted on at once by two powers will not move in the direction of either, but in the diagonal of a parallelogram, of which two sides are formed by the direction and momentum given by each of those powers respectively; so every change of impulse or resistance will cause the body to move in so

the collision of a ball, or other rounded substance, and the deviations in its course, on mathematical principles and the laws of matter; and although they may afford a more probable conjecture on the subject, they are by no means, in my mind, satisfactory or adequate to account for the extent of injury or disease that takes place, or the deviations in the course of the ball. If the body were an inanimate substance, the extent of the injury might be estimated in this manner; or if it were composed of known substances of equal densities or

many changes of direction, till at length its momentum is overcome, and it becomes quiescent.



Suppose, therefore, any body, a shot for instance, represented by A, to be moved by a power with the velocity and in the direction A C to B, where it meets with a new impulse, with the momentum and direction B D, it will move in the line B E, the diagonal of the parallelogram B D C E. Now being acted upon by a new power or resistance F G, it will have its direction again changed, and will move in the line F H, the diagonal of the parallelogram F E G H; if at I another power or resistance I K act upon it, it will move in the line I L, the diagonal of the parallelogram I H K L: and if it meet with no further power or resistance to change its direction again, will stop at L. But if it meet with any other power, or if any power still operating upon it be subtracted, its direction will change accordingly.

powers of resistance, the course of the ball might be calculated; but it is composed of parts that are possessed of life, of the powers of contracting with energy, of opposing at one time a greater resisting force than at others; and of varying the force during the passage of a ball through its substance, either by a spasmodic or natural contraction of the parts, depending upon their muscularity or elasticity in a manner that constantly varies, and which we cannot estimate, because we cannot know in what manner or when it has been employed. In searching for a ball, which cannot be immediately discovered, we shall frequently find it where we have no suspicion of its lodgment. In this case, I have no doubt it has obeyed the laws which are indicated; but it is impossible to discover it, in most cases, from a consideration of those laws *a priori*, because we know not the state in which the parts were, through which the ball passed at the moment of injury, nor the resistance they may have afforded. We are equally unaware of the force with which the body is impelled. Being ignorant, therefore, of the force of impulsion and the power of resistance, which in an animal body is always changing, it appears to me next to impossible to ascertain by calculation the course pursued by balls; and we accordingly find them in places where we could never suspect them to be lodged. I by no means wish to undervalue the mechanical or rather scientific manner in which Mr. Chevalier would explain the nature of these injuries; I only wish to doubt the complete application of these rules to the human body, and to caution the younger military surgeon against placing too much dependence upon them. He should never forget that he is considering the human body, which is possessed of vitality, and not to be regulated by physical laws. A shot through the lungs will cause an instantaneous derangement of the whole system, but the resistance afforded by the part has little to do with it; it is the lesion of the organic functions, intimately connected with life, that is the cause of the derangement. In the same manner, I do not conceive

that the general affection of the system depends alone on the shock received, or the resistance opposed to the force of the body impinging, but on the effect the injury committed has on the nervous system; for instance, two men may lose their legs by the same cannon-shot, or two shots from the same battery, whilst in the same situation: the force of resistance and of impulsion will be nearly equal in both, yet the general affection will be very different; in one, so great as to destroy life; in the other, it may only be perceptible in a moderate degree, depending not upon any difference of mechanical force, but of the powers of life or vitality.

The nature of the injury having been ascertained, we are next led to the mode of treatment; and it is at this point precisely, in the management of gun-shot wounds, that it is necessary to turn our attention to the constitution of the patient, as well as to the nature of the injury, in order that we may not be deceived in the estimate we are about to form of the chances of success or failure. Inattention to this point, or too much reliance upon theory or preconceived opinions received from authority, have been the causes of the great differences that have arisen in practice, and which have appeared in gun-shot wounds in every other respect similar.

Simple gun-shot wounds of muscular parts, which have been inflicted by substances passing through with *great velocity*, are more or less contused wounds, and do not heal or unite by the first intention. The ball has forcibly torn its way through the soft parts; and by the quickness with which this has been effected, they are deprived in part of their sensibility and life; but there is no absolute loss of substance, there is none driven out. The parts actually touched by the ball may be totally destroyed, the sensibility of those immediately in succession will be considerably deranged, and extending towards the sound parts until the degree of deviation from the state of health is lost in the surrounding substance. It has been attempted to give a degree of mathematical precision to an explanation of the nature of this injury,

by describing a figure in concentric circles, the internal one indicating the hole made by the immediate passage of the ball; the next, and more external ones, denoting the different changes which have taken place in the sensibility or actions of the surrounding parts. This explanation would be correct, if a part were one homogeneous whole, possessing the same texture, vitality, and powers of resistance; but as this is not the case, and, on the contrary, every part is differently constituted, so do we find that a ball in its passage through a part is the cause of a different kind of injury to each particular texture that it touches, the extent of which is not regulated by any mathematical precision, bnt by the natural power of the part and its peculiar sensibility. The death of every texture does not, then, take place to the same extent on all the sides of a wound, as I have distinctly and particularly instanced to be the case with arteries. The slough which comes away is never equal to the extent of the wound, and it is perhaps only at what may be termed the orifice of entrance that its circular form corresponding to that of the bullet is distinctly marked. Neither does the death of the part injured take place to its utmost extent at the moment of injury. The small vessels throw out their blood, and this discharge diminishes, and finally ceases, as their life is exhausted; the sensibility of the parts behind being diminished, the blood does not pass freely through the vessels, and the cellular substance at the orifice and commencement of the wound, looks of a livid colour, as if full of blood. There is a bloody discharge from the wound, which is increased on pressure; there is a little bluish discoloration of the skin surrounding the openings, particularly that of the entrance of the ball; and, in most cases, there is pain of the part, and uneasiness of the limb, from the instant of the infliction of the injury. The track of the ball is then partially filled with matter deprived of life, and which must be discharged, before the part can be restored to its natural state; but this dead matter retains its attachment to the surrounding

substances, and must be removed by the process called sloughing, and which, in this instance especially, is dependent on the actions of other parts, which have been themselves subjected to the unequal range of injury committed by the ball. When these actions commence in parts which have been injured, although not deprived of life, they are often unable to sustain them, and, in turn, die, depending again upon the strength of those further from the wound for their separation; so that, after the process has continued for a few days, the track of the ball, even under the most favourable circumstances, is much larger than it was at the moment of injury; whilst, if the constitution and the powers of the part be bad, or unequal to the support of the necessary actions, the death of the whole ensues, instead of the death of a part.

Inflammation is the process of nature, by which the repair of injured parts commences, and on the due management of which in gun-shot wounds our good and bad success depends; but inflammation is itself dependent on the powers of the constitution generally, and of the injured part particularly; we must then look to it as the regulator of our practice, the arbiter of our good or bad success.

Mr. Hunter, who filled the office of Surgeon-general to the army, has said, in his work on inflammation, "that whatever is to be the consequence of injuries, especially inflammation, is produced much more readily in a strong constitution than in a weak one. A wound, for instance, made upon a person of an healthy constitution and sound parts, will unite almost at once; it admits readily of an union by the first intention. A greater strength of constitution, and of parts, admits of resolution, while in the adhesive state of inflammation, very readily; and, therefore, tends much to prevent the suppurative inflammation from taking place, for it gives a better disposition to heal by the adhesive, so that the union of parts by the first intention, the inflammation and resolution, as well as the readiness to change from the one to the other, according as the preceding is prevented, depends equally upon

the strength and health of constitution, and parts inflamed. We may also observe, that a greater strength and soundness of the constitution or parts inflamed, when inflammation has got beyond the stage of resolution, and has assumed the disposition for suppuration, hasten on inflammation and suppuration, and also bring it soon to a termination; whilst, at the same time, the matter is brought more quickly to the skin by ulceration."

"Whatever is the step which nature is to take, whenever an injury is done, or a necessity for inflammation has taken place, it is performed with readiness and facility in strong constitutions and parts*."

At page 233, he says: "As the effect which this inflammation has upon the constitution is by sympathy, it must be in proportion to the readiness with which the constitution assumes that action. This susceptibility is stronger in some constitutions than in others; and every constitution is more susceptible of sympathy with some parts of the body than with others."

"The kind of constitution, which is least affected by this inflammation, is that which is in general most healthy, where sympathy hardly takes place; this happens to be the case with such constitutions as can most readily perform all the different operations with ease; and when the parts inflamed are able to manage their own business, they thereby affect the constitution less; for we shall find, that a constitution may be affected by a local disease, merely because it is beyond the power of the part to cure itself."

So far Mr. Hunter reasoned from observation, and is supported by facts; his subsequent remarks on the same subject are deduced from experience, and are partly supported by facts; but from a wish to generalize too much, in order to form a perfect theory, his meaning has become, in part,

* Mr. Hunter on Inflammation, especially Chapter II, On the Fundamental Principles of Inflammation.

doubtful, and in a practical point of view might have done much mischief, if the observations of practitioners had not opposed the illusions of theory.

Weakness of constitution and weakness of parts, Mr. Hunter naturally opposes, in the same Chapter, to soundness of constitution and strength of parts, and as inducing opposite effects, which will be readily admitted; but being aware that objections might be brought against this theory of apparent strength and weakness of constitution and of parts, and especially from the circumstance of inflammation not taking the course he had laid down, in many persons apparently of a sound constitution, and particularly after accidents, he was induced to add the following explanation to his theory, the reasoning of which cannot, I conceive, be reconciled, by any ingenuity consistent with facts, with his preceding statements; and that the facts of the case are decidedly against it I shall fully demonstrate, when on the subject of Amputation.

He says in continuation, page 233, "But it is to be observed, that constitutions in full vigour, or which have not been in the smallest degree accustomed to local disease, take the alarm much more readily than those which are not in such full health, or which have been accustomed with local disease. Thus, if a man in perfect health gets a very bad compound fracture in the leg, or has his leg taken off, either for this fracture or in consequence of any other accident, he stands a much worse chance of recovery than one who has been accustomed to a local disease; even the man with the compound fracture will do much better if his leg is not taken off till the first symptoms are over; or at least we may be certain, that the symptoms arising from the amputation will not be nearly so great as those arising at first from the fracture, or would have arisen from the immediate amputation. This would appear to be a contradiction to the above position; but upon an accurate investigation I think it may be accounted for; for, first, I do not look upon full health as the best condition to resist disease; disease is a state of body which requires a

medium; health brooks disease ill, and full health is often above par; persons in full health are too often at the full stretch of action, and cannot bear an increase, especially when diseased; and, as I before observed, it is a new impression on the constitution, and till it be in some degree accustomed to local disease, it is less able to bear such as is violent; besides, the removal of a diseased part which the constitution has been accustomed to, and which is rather fretting the constitution, is adding less violence than the removal of a sound part in perfect harmony with the constitution; the difference, however, is not wholly owing to that cause, for the circumstance of a constitution being accustomed to a mode of life, &c. which it is to continue, makes a considerable difference."

Mr. Hunter has here supported his opinion by an inference drawn from the bad success of some operations of amputation; but it appears to me, on attentive consideration, that he drew the inference first, and afterwards shaped his theory to it. If this should have been the case, the stability of the theory is entirely dependent on the truth of the supposed facts from which the inference was deduced; and, as I shall show them to be erroneous, when on the subject of Amputation, and as they are distinctly admitted to be so by every army and navy surgeon in Great Britain, by most surgeons in civil life, and by every foreigner of the slightest attainments, this part of the theory must fairly sink with the foundation on which it was erected. The apparent contradiction, which Mr. Hunter himself admitted, is by no means removed by the explanation he has given; but is, on the contrary, more fully established. The circumstances, from which he drew his inference, and which he considered as facts, remain; but they are to be accounted for in a very different manner.

If Mr. Hunter had lived a few years longer, he would have rectified the error; he would never have opposed (as many of his pupils have done) theory to facts, and obstinately persisted in that, which can neither be reasonably nor justly maintained.

In grounding our practice on the theory of strength and weakness of constitution and of parts, which Mr. Hunter has established as his basis; and in throwing off the exception, which has not been found consistent with facts and observation, we are only doing what he would himself have done. The surgeons of the army revere his memory, and are proud to think that the first surgeon in the army was alike the first surgeon in civil life. They are not then likely to undervalue that work, which has rendered his name immortal, and the basis of which he acknowledges to have been founded on observations made in the army; they only wish, for the sake of mankind, to impress upon their brethren and his successors the simple fact, that knowledge is never stationary; and that, although Mr. Hunter did more than any one man could be expected to do for surgery, there is still something to be done: that it is not sufficient for us to repose under the shelter of his name, but, by endeavouring to imitate him, render ourselves more worthy of the honour we enjoy of being his countrymen.

That surgery is not an art dependent on manual operation and dexterity alone, is, in truth, nowhere so well exemplified as in those cases which require the greatest exhibition of both; for we find, that, although the operative part has been performed with the most scrupulous nicety, we are still dependent on the natural powers of the constitution for ultimate success; if these fail, our dexterity is unavailing, whilst, if they are equal to our wishes, we shall be often successful, although the operative part should not have been so happily accomplished. How many operations do we not daily see fail, contrary to our expectations? and on reflecting on the causes of our failure, are we not perpetually referring to the state of the constitution, rather than to the mode of operating? Are we not obliged to confess, that there is a peculiarity in the constitution of every person, although there may be a general similarity in the whole? Do we not perceive, that these again are modified by a variety of circumstances, of

age, of climate, of disease? and ought we not to be convinced, that it is only by a careful steady comparison of these peculiarities, under every variety of circumstance, that we can attain a general knowledge of the capability of each under disease?

This study, this comparison must be made, however, on an enlarged scale; the enlightened surgeon should imitate the ruler of an empire, who, in bringing within his observation the peculiarities of each of its component parts, and providing for one without injuring another, legislates for the poor as well as the rich, for the whole empire as well as the metropolis. He should carefully examine the progress of disease in every constitution, and under every variety of circumstance; he will not fail to observe, that the state of health of an inhabitant of a large town is sometimes different from that of a person residing in the country; that this is subject to great modification; and that there is again a difference between the rich and the poor of both, independent of age, habit, or irregularities of conduct; he will accurately ascertain the state of health in each of this description of persons, to enable him to judge of the alteration that may occur during disease; and he will then be convinced, that he cannot form a general rule for the whole from the study of any one peculiar class, without subjecting himself to constant error, any more than the legislator of a great empire can govern different nations by the same laws that are adequate to the maintenance of order in the metropolis.

In fact, the surgeon must have the same expanded views. If, unfortunately for society or himself, he take only one view of disease; if he treat all persons by the same rule, by that standard of health to which he is most accustomed, he can neither be generally useful, nor highly eminent in his profession: to carry on the comparison, he can only be respected as the magistrate of a city, not the legislator of a country.

When I alluded, in the first edition of my work on Ampu-

tation, to the opinions of several of the gentlemen who advocate, on this erroneous principle, the propriety of delay in cases of injury where amputation was clearly indicated, I endeavoured simply to refute them by facts, which I was disposed to hope might be sufficient, although I feared they would with some be unavailing. The theory on which their opinions were founded I hardly noticed; but the more often I have since that period examined into it, the more firmly am I convinced that it is maintained, by the few who still persist in it, from the partial views alluded to, and not from that extensive consideration of the subject which its general importance to mankind demands. I believe it has arisen from laying down one standard of health to reason upon, instead of many. If we ask, are the constitutions of a robust countryman, a healthy tradesman, a luxurious man of fashion, a nervous lady, a drunken spirit-drinker, alike, there will be no hesitation in replying in the negative; yet each of these persons may be in a perfect state of health, according to his own standard, every function may be performed with the greatest regularity; but let them be attacked by disease, and then the difference of power of their respective constitutions will be immediately perceived; one has the means of resistance, whilst another, although in health, may be, as Mr. Hunter has expressed it, at the full stretch of action, and cannot bear an increase, having no means of resistance; like a set of springs from particular manufactories, they may all look externally alike, externally good; but when we put them into high action, we find many of them break, and are unable to sustain it; still we should not be justified in condemning the whole because some of them were bad; we must, on the contrary, endeavour by a stricter scrutiny to find out which of them are deficient in that quality we seek for, that we may regulate the action according to the power. In the same manner, if certain qualities be necessary in the human body to enable it to support and resist disease with effect, it does not follow, because some persons only have the appear-

ance of them without actually possessing them, that we are to conclude they are unavailing; on the contrary, we must endeavour to distinguish between those who only appear, and those who do really possess them.

A state of high health is opposed to that of disease, as two extremes; but between them there must be very many shades of difference; and although this difference may be scarcely perceptible between any two, it is well marked at various stages or intervals. As a datum to proceed from, we must select that which is the most perfect, not only in appearance, but as to fact; and I have no hesitation in saying, that it will be found among persons from fifteen to forty years of age, who possess a constitution capable of suffering an increase of action, or an abstraction of any stimulus or power, with little, and, at all events, no permanent inconvenience; being a state of soundness of constitution, and strength of parts equal to the support, for many days, of that general derangement called fever, and, if there have been no local derangement, remaining at its termination without disease, but in a state of debility; or persons capable of sustaining an injury, attended by the loss of a large quantity of blood in a few hours, and rapidly recovering from it with symptoms of debility only. This, which is the most prevalent state of constitution, I consider as the most healthy, and the state to which Mr. Hunter's theory applies; and so far from a person enjoying this state of robust health being above par, and incapable of sustaining an action above it, it is in my opinion exactly the reverse; he is able to support an increase in a moderate degree without inconvenience, and in a very violent degree without detriment, provided the powers maintaining it be adequately reduced. In other words, when great inflammatory fever or inflammation come on, either of which is a great increase of action, the patient can bear it for several days without any permanent detriment, provided he lose blood in proportion to the increase of action, in order to prevent its destroying the texture or function of any vital

part. If this be not done, the patient must be very soon carried off, because the action will increase so rapidly as to be soon incompatible with life, unless relief be obtained. The great difference between good and bad constitutions on this point is, that this inordinate action can be repressed and removed in a person of a sound constitution, without leaving any bad effect behind; whilst in a bad one, the same, or even an inferior degree of action would inevitably destroy; because the powers of the patient would neither be equal to support the action, nor, having supported it, recover from it; nor even to bear the means for its suppression. The remedy would be as bad as the disease. In good constitutions the increased action may, by moderate bleeding, be so balanced with the general powers of the system, that inflammatory fever, or even local inflammation, may go on for several days, and at last terminate, under proper treatment, without detriment. In bad constitutions this is impossible, for if evacuations are at all indicated they must be effected in the first days, I might even say hours, for the patient will otherwise be unable to bear them; his powers will sink, and the fever, or inflammation, will be brought to an unfavourable termination. A good constitution can bear a high action and a direct reduction of power, for a sufficiently long time. A bad constitution can bear neither for half the same period; and if the reduction of the action is to be attempted by reducing the power (that is, by bleeding), it must be done at the commencement. Persons of bad habits will almost always bear bleeding once. Old people bear it much better. I am quite certain, from long experience, that many of both descriptions are continually lost, from a want of decision in practice in the first instance. An ulterior state of disease is too much regarded, and the consequence is, that we have so many unfortunate sequelæ.

If we refer to the systematic works on medicine of Great Britain, or what are called systems, in which all diseases are enumerated, for I will not call it by any other name, it will

be found, that sixteen ounces of blood is the largest quantity ordered to be abstracted in any acute inflammatory disease, either of the brain, heart, lungs, stomach, or intestines. Now, in none of these diseases will that quantity suffice: if the constitution be good, and the action high, it may mitigate its violence; but it will not, even if repeated at the end of a few hours, remove the disease, as it is termed, by resolution. I am perfectly aware, that in many books of very late date, and in modern practice, the quantity abstracted is often doubled, and more frequently repeated; that bleeding is regulated by effect, and not by quantity: by effect, as considered with relation both to the disease and the constitution of the person. But this change has only been effected, like the change of opinion in regard to amputation, compound fractures, &c. within the last few years, and mainly from the opinions of army and navy practitioners, who have this inestimable advantage in the improvement of the practice of physic, that, seeing their patients from day to day previously to the commencement of the disease, they can duly estimate their powers, they can then watch the course of the complaint, and its termination; and, from a certain number of well-marked cases, can judge of the powers of the system generally, and the effects of remedies in different cases; whilst practitioners in civil life are often only called upon when the disease has advanced to a stage that does not admit of immediate or a complete removal, or in which it has so altered the actual appearances of the persons from which we judge, that a correct estimate cannot readily be made of the powers of the constitution.

In the spring of 1801, the regiment to which I belonged was exposed to the sharp winds on the Berry Head, the southerly headland of Torbay, and many suffered from inflammation of the lungs, some strong, some weak persons, others old, others young, and of variously estimated constitutions. I treated them as I had been taught in London; almost all those who were first attacked, young or old, died; and as I went through the whole treatment, and examined the

bodies after death, I found, that, in all, the disease sooner or later had gone on to suppuration. On due consideration I could not find any thing to accuse myself of; I had allowed for difference of country life, &c. and yet I had not done more than temporarily mitigate the disease. The officers of the regiment, who had been led by the late Mr. Rush, who was my patron and friend, to think me as well qualified as any other of my standing, began to be uneasy, and it became necessary to meet the difficulty. I made up my mind, that the next case of pure inflammation should not terminate in suppuration, whatever else might be the result; instead, then, of attending to the pulse, and to the quantity of blood drawn, I only considered the general capability of my patient, and knowing his constitution to be good, I bled him until an obvious effect was produced, until the breathing became free, and the pain was nearly or entirely removed. This man rapidly recovered; so did others in succession; indeed since that period I have hardly ever lost a case that I have seen in proper time. I had found the clue I wanted, to remove me from the labyrinth in which I was involved; and it was a leading incident in my life. I gained the approbation of a body of men, who were for a moment doubtful, but who, after a lapse of twenty years (those of them who survived that eventful period), bestowed upon me as a public mark of their esteem, and acknowledgment of services rendered as surgeon of their regiment, the most valuable present that has yet been offered to any officer of that rank.

Two years afterwards, in America, I received another esson in a disease which runs its course in a much shorter period —inflammation of the bowels. I lost a patient at the end of two days, although I treated him with greater activity than is usually recommended; a second followed the same course: they were as usual examined, and the principal medical officer on the station, on his own inspection, was satisfied that they could not have been saved; but this did not satisfy me; my former lesson was not forgotten: I was not a predestina-

rian, and was sure I had either done too much or too little. The decision was in favour of the latter, and an opportunity of proving it was not long wanting: a strong able-bodied grenadier had, on receiving his month's balance, absented himself for the remainder of the day and the night, and was only discovered early next morning, in consequence of his sufferings rendering it necessary for the people with whom he was to apply for advice. The man had gone to bed intoxicated, but not so drunk as to be unable to speak or walk, and had been writhing for several hours with pain in the belly. He confessed to having drunk a gallon of spirits during his absence, and it was evident there was now no time to lose. It was the case I wanted, and I instantly bled him, in the horizontal position, in a pewter wash-hand basin, until he fainted. When able to answer, he said the pain was easier; but as it continued half an hour afterwards with greater severity than was compatible, in my opinion, with safety, the bleeding was repeated, which relieved him greatly; and again, for the third time, two hours afterwards; the bowels became open, and I felt myself in the right; a dose of calomel and opium, and a blister to the abdomen, &c. &c. effected a cure; and I have seldom lost a patient from enteritis since, except when caused by external injury.

Colonel Barns, of the Royals, of a spare habit of body, was wounded at the battle of Salamanca, in 1813, by a musket-ball on the left side, which injured the cartilages of the lowermost false ribs, and broke the bone, a portion of which separated, and was removed; the liver was also injured; the bilious discharge from the wound continued for several weeks, and his life was saved with great difficulty, principally by the unremitting care and attention of Staff Surgeon Walther, then Assistant Surgeon of his regiment. During this period I saw him, and considered his case as peculiarly interesting. The wound closed, and Colonel Barns was enable to return to his duties, although suffering from a sensation of dragging pain and weight in the side, which was increased on any exertion,

either of riding, walking, or speaking, and sometimes becoming acute. When in Scotland, he suffered from an attack of acute inflammation, and only escaped with life under the kind and judicious advice of Dr. Paterson of Ayr. He was now induced to come to London, and in the autumn of 1819 he was again attacked in the most serious manner, whilst under the care of my colleague, Dr. Charles Forbes, of Argyle Street. The pain in the right side, extending over the stomach, and down to the umbilicus, was constant, acute, and increased on pressure, the pulse very small, indeed scarcely perceptible, the extremities, especially the feet, cold and uncomfortable, the countenance depressed and extremely anxious, bowels confined, and the stomach rather irritable; a number of leeches had been applied, and other remedies administered. Under such urgent symptoms it became necessary to act decisively; and Dr. Forbes and I agreed, that the *constant pain*, which was increased on pressure, ought to regulate the practice to be pursued for the removal of inflammation, although every other symptom seemed imperiously to forbid depletion. I bled him, whilst Dr. Forbes kept his finger on the pulse, his eye upon his countenance; and as the one did not diminish, but rather increased in force, and the other became if any thing less anxious, I abstracted twenty ounces before the arm was tied up; the pain now diminished, and he felt relieved; but it shortly after rather increased, and in the course of an hour we decided on taking away twelve ounces more of blood, which was done with the most beneficial effect; a blister was applied over the part, and a dose of calomel and opium was repeated. He shortly became tranquil, the pulse rose, the extremities lost their coldness; he dozed a little early in the morning, and although the pain continued in a slight degree for several hours, and much soreness remained for many days, we had no hesitation, on the bowels becoming open, in pronouncing him out of danger. Two months afterwards, in consequence of walking about two miles rather hastily, he had another and equally severe attack

of the same nature; but there was now no cause for doubt, and he was relieved in the same manner. He found, that whenever he bent his body, a portion of the rib seemed to press in on the liver, and often gave him acute darting pain; and on pulling on his boot rather hastily and with some bodily exertion, a third attack ensued. It therefore became necessary to prevent the bending of the body forward, and as much as possible to confine the motion of the liver, which seemed to have formed such close adhesion with the peritoneum of the parietes of the abdomen and diaphragm, as to deprive it altogether of that sliding motion of which it is naturally capable, and consequently to expose it to the slightest degree of pressure made upon the irregular points of bone, which can be readily distinguished on a careful examination. To effect this, stays were adapted to the body, with iron plates instead of whalebone, and he has obtained the greatest ease from their use, as well as having avoided a return of the inflammation. Once only has there been any tendency to it, and then the pain evidently originated in the stomach, instead of the region of the liver; and continued for several hours, until he fell asleep; on its returning after dinner in the same manner for several days, calomel, opium, and purgatives removed it; but it became necessary to give the opium in the quantity of a grain and a half two hours before dinner, and the purgative of equal parts of the infusum sennæ and the decoct. aloes comp. every morning. This case is throughout a well-marked instance of the advantages to be derived from a correct diagnosis and decisive practice. At one period the pain was entirely dependent on inflammation, latterly on spasm, and derangement of the primæ viæ; but if the two had been mistaken, and the treatment adopted for the one had been substituted by the other, the result would have been deplorable. I do not believe that the substance of the liver was ever materially affected by the inflammation, but the treatment, as far as regards depletion, was not in the slightest degree less vigorous than it would have been had the organ itself been

principally implicated. The only difference of any consequence would have been a more protracted illness and medical treatment.

I am accustomed in my lectures, when on the peculiarities of constitution, and the consequent treatment of inflammation, to draw a parallel between inflammation and spasmodic affections, and to illustrate it, by reference to the diagnosis between colic and inflammation of the bowels, in order to point out the necessity of a just discrimination between them; the inflammatory disease requiring a vigorous and effective immediate treatment to save life, whilst the spasmodic affection may be often mismanaged, or inertly treated, without any serious detriment ensuing. I now dwell on it, because it is necessary to establish the doctrine and practice I shall subsequently recommend; and it seems to me that an error of great magnitude may, and is actually creeping into notice, which cannot, I apprehend, be too soon unmasked. It has arisen, not from too minute attention to morbid anatomy, for that is impossible; but from combining the facts which it has yielded, without sufficient reference to the preceding symptoms. The error I allude to is that of considering the diseases of each tissue or texture of the body separately, and without due attention to their intimate connection and mutual dependence on each other. I refrain from noticing foreign authors on this subject, to avoid a multiplication of references, especially as the pith of their observations have been brought before us in the Medico-Chirurgical Review, by Dr. Johnson*, to whose zeal and

* Analytical Series ..... vol. i, page 161 to 195
vol. ii ..... 1 — 41
vol. ii ..... 695 — 732
vol. iii ..... 465 — 495
vol. iv ..... 487 — 511
New Series ..... vol. i, ... 265 — 285
vol. ii ..... 326 — 335

ability the public is greatly indebted. It is there stated, in consonance with the views which have resulted from the pathological labours of the French practitioners, that the peritoneum is the part or tissue which is originally invaded in the greater number of instances, and that the disease takes its name, IMPROPERLY, from the organ over which the principal inflamed portion of peritoneum is spread. By this, it is intended to abolish the names of gastritis, enteritis, &c.; and to adopt the term peritonitis in a sense different from that in which it has been hitherto entertained. I am led to this presumption from observing, that the disease usually denominated enteritis is treated of under the head of peritoneal inflammation; and a discussion occurs as to the simple circumstance of whether the bowels are costive, or otherwise, during the attacks of inflammation; a fact which is decisive, in my mind, of the impropriety of allowing the diagnostic and essential symptoms of disease to be discarded or overlooked, for the sake of the nominal and unimportant designation of it. The peritoneum is not, of itself, a vital organ, in the true acceptation of the term; and only becomes so when it is intimately connected with one. Thus, the peritoneum lining the parietes of the abdomen, is by no means of so much importance in the animal economy as the peritoneum covering the intestines; which fact is distinctly shown, not only by inflammation attacking these parts, but by the symptoms. The result of acute inflammation of the peritoneum covering the intestines, inertly treated, is usually death at the end of from twenty-four to forty-eight hours; whilst acute inflammation of the peritoneum lining the walls of the abdomen, may continue for several days, or at least twice forty-eight hours, without causing death, and will often, under very inert treatment, become a chronic disease. *Acute* inflammation of the peritoneum covering the bowels does never take place without the bowels being costive. Dr. Pemberton says, they "are ob-

stinately costive;" and, supported by such an authority, I will not make an exception to the rule in *pure acute* inflammation, whilst I admit the frequency of its occurrence in pure acute inflammation of the peritoneum lining the walls of the abdomen. I contend, then, that whenever it is possible to make so correct a diagnosis as to enable us to ascertain, or even to suspect, that it is the peritoneum covering the intestine, the stomach, &c. that is inflamed, the disease should be named from the organ that is affected, for if it be not at the beginning affected, it cannot long remain so. If the inflammation should have attacked more viscera than one, the disease should be named from the most important; the term peritonitis should be confined to the inflammation of that part of the peritoneum lining the walls of the abdomen alone. Or if it be considered wise to refer to the texture, at least let the name of the subjacent viscus, or viscera, be attached to it. It is admitted that the absence of redness in the peritoneum is no proof that previous inflammation did not exist; the same is allowed in regard to the skin, yet no such allowance seems to be made for the other tissues or structures of the stomach or intestines; for if they are not actually altered in texture, they are pronounced sound and unaffected, although during life they have, like the peritoneum, shown every sign of suffering from acute disease. The same signs are discoverable in other fatal cases, where the whole texture of the part is greatly altered, or even destroyed and mortified. We presume then to pronounce, that parts, which are so intimately connected with each other as the different coats or tissues of an intestine, are all sound, except that one which is in a high state of inflammation; whilst at the same time we acknowledge the great, and almost insurmountable, difficulty of deciding in the examination of this very part, how much is due to congestion, how much to inflammation, and, in some particular cases, whether the appearances are actually dependent on one or the other. I

beg to be understood as always alluding to acute, and not to chronic cases; and I should be most happy to be informed, which, or what, are the diagnostic signs or characters by which a true inflammation of the peritoneum covering the intestine, likely to prove, or which has proved fatal, can be distinguished, during life, from one which has also invaded its proper substance. At present I knew of no such characters, not even when suppuration has been induced, as the following case will show, in which there were no unusual symptoms.

A soldier, quartered in the Strand barracks, was taken ill after some irregularities, and was confined to his bed one day without his illness being reported. On the second day he was seen by the usual medical attendant, and on the third sent to the York Hospital, Chelsea. On his arrival he complained of intense burning pain at the stomach and umbilicus, which was increased on pressure, was always present, although sometimes more violent than at others; the stomach was irritable, rejecting every thing, the bowels were constipated, pulse quick and small, countenance expressive of anxiety and pain, the skin hot. Active depletion, and the other usual remedies, were employed in vain, and on the third day after his admission he died. Being accidentally in the dead house, I opened the body, and was equally surprised to find no marks or signs of inflammation on the intestines near the navel, to which the greatest pain had been referred, and to see the stomach much enlarged, of a whitish colour, and so changed from its natural appearance, as to resemble the thick smooth part of boiled tripe. On cutting into it, I found it nearly as thick, in consequence of the cellular membrane between its coats being loaded with matter resembling pus, which could be easily pressed out, leaving a honeycombed appearance, in addition to the very unusual thickness of the stomach, which was evidently in an equable state of suppuration throughout. I removed the stomach, and gave a part of it,

in its recent state, to Dr. Hooper, in whose museum, and the medical one at Chatham, the only specimens of a disease are to be found, which has not hitherto, I believe, been described in any book of morbid anatomy. The formation of an abscess in the stomach, although a rare disease, has sometimes been met with, and is generally fatal.

If there be a symptom more observable than another, it is one, which is yet common to all vital organs — I mean anxiety. The able observations of Dr. Dickson, of Clifton, noticed by Dr. Johnson, allude to this, although they more properly refer to the appearance of the countenance, as indicative of pain. The anxiety I intend to distinguish as a symptom, I have alluded to in dangerous wounds, and is not only of the mind, as shown by the countenance in a very expressive manner, but of the body, as demonstrated by great uneasiness. Anxiety is constantly observed towards the fatal termination of acute diseases; but when a vital organ is affected, whether it be its internal structure or not, this symptom is often present at an earlier period. In some cases it is a more certain sign than the pulse of great derangement; in others, more distinctive than pain, which is sometimes referred to a part that is unaffected, and is, in all, indicative of the greatest danger, and demonstrative of the necessity of corresponding exertion on the part of the practitioner. In the case of gastritis, which I have related, the pain was referred so stedfastly to the region of the navel, that enteritis was looked upon as the principal disease, whilst no sign of it could be discovered after death in the parts corresponding to it.

In the year 1813, when at Lisbon, I met with several fatal cases of inflammation of the heart in hard drinkers, and of metastasis of rheumatic inflammation. In none of these were the symptoms very strongly marked; indeed inflammation of the heart frequently exists without being suspected, and more particularly when combined with inflammation of the chest.

The symptoms most usually relied on are the frequent occurrence of syncope and the irregularity of the pulse; but they are not always present. Portal says, "Sometimes a most acute attack of carditis is accompanied by syncope, the cause of which cannot be misunderstood; but at others, the symptoms of inflammation are so little marked, or even observable, that if syncope supervenes, the cause is not known, and the true character of the disease is misunderstood, until dissection demonstrates an inflammation of the heart*."

"There is another and not uncommon species of carditis, which is not indicated by the acute symptoms we have enumerated. It is that which sometimes follows ardent or malignant fevers, and even the plague. It occurs after divers metastases, such as rheumatism, gout, erysipelas, &c. &c., and which species is very seldom discovered but on dissection." Portal supports his opinion by references to Morgagni, Senac, Lieutaud, &c., and it coincides with my experience. There is one symptom I have remarked, however, in an extraordinary degree, in all the cases I have seen, and that is *extreme anxiety;* and in a much greater degree than other symptoms would appear to warrant, or than can be accounted for from the apparent nature of the disease. In obscure cases of inflammatory affections of the chest, I consider it more constant, more pathognomonic of carditis, than fainting or irregularity of the pulse.

In a case of acute inflammation of the chest following the cure of stricture of the urethra, in which I had the benefit of the opinion of that able physician Dr. James Forbes, the only symptoms present, except extreme anxiety, were of pneumonia. The inflammation of the heart was not suspected. The pulse was regular, the patient not subject to faintings. After death, the pericardium and heart were found highly inflamed, thickly coated with coagulable lymph,

* Portal, Mémoires sur la Nature et le Traitement de plusieurs Maladies, p. 166 et seq. Paris, 1819.

and a considerable quantity of fluid, in part resembling purulent matter, was found in the cavity of the pericardium. The preparations of the heart, and of the urethra, are now in the Military Medical Museum at Chatham, and are both of them very valuable of their kind.

Anxiety is then a symptom deserving the strictest attention in all affections or injuries of vital organs, for, whilst it is present, although other symptoms be mild, the patient is always in imminent danger.

A soldier applied to me for an external injury, labouring at the same time under some internal complaint, for which he had been recommended to take bark, on the supposition that it was an ague. I found on inquiry, that the paroxysms were not regular, that the rigors were only slight shiverings, the heat was permanent, the skin dry, the sweating stage absent, pulse from 112 to 120, and a peculiar expression of anxiety of countenance that could not be accounted for. From this symptom I conceived that bark was improper, that the disease was not ague, that something more serious was impending: my opinion was not received, the bark was continued, wine mixed with water was allowed, but the man did not amend. The rigors, it is true, were suspended, and so was the bark, but the skin remained dry and harsh, the pulse always quick, sometimes full, the anxiety constant, the body rather wasting, although the appetite was better than could be expected. In this state he was removed to the country, for the benefit of the air, the complaint being considered nervous, the abdomen indicating no signs of derangement on pressure, nor the chest on inspiration. I still predicted an explosion, which would develop the mischief, and gave a caution on the subject. This development occurred suddenly, in the shape of a paralytic affection of one side, and examination after death showed the formation of an abscess on the opposite hemisphere of the brain. He would have been reckoned a rash and ignorant man, who would have advised the abstraction of blood from this patient at an early period of the complaint. I believe, reasoning from the result, there

are none of us, who would not have done it. A few ounces of blood from the jugular vein might have saved the life of a valuable man*.

There are two things, then, which I wish to impress on the minds of students; first, that a peculiar degree of anxiety, in an early stage of disease, is indicative of great derangement of some important and vital organ; and, secondly, that on reading foreign authors on wounds and inflammatory diseases, they should remember that inflammation seldom runs so high or so rapid a course in foreigners, and especially in the natives of warmer climates, as in our countr men; that the necessity for depletion is never so great; and that very many inflammatory complaints, which, under the inert practice of a foreign physician or surgeon, terminate favourably, or in a chronic state of disease, would with us destroy the patient in a few days. I consider this fact of so much importance in the prevention of error, that no student should read such works without first repeating it†.—To return to the importance of a due estimate of the powers of the constitution on the one

* Bleeding from the jugular vein is, in my opinion, much more effectual in all cases of internal derangement of the head, than from the temporal artery, or any other part. I believe it to be particularly so in cases which may be denominated chronic, or in low obscure inflammations or congestions. I have several people attending at my Infirmary for Diseases of the Eye, in whom the advantages of it have been most striking. In some cases of fits resembling epilepsy, it has put a stop to the disease. In epilepsy itself it has been useful, and in amaurosis from pressure on the brain, in congestion, and in impending paralysis, it has been of the most marked utility, when other general and local bleedings have failed.

† In India, I am informed by Mr. Paterson, the fact is so well established, that no practitioner would think of treating a native in the same manner as he would an European, for any wound or inflammatory disease: and the symptomatology of these people might as well be applied to the diseases of Englishmen, as the medium rate of violence of symptoms of foreigners, to the more violent and rapid course of the same disease in natives of Great Britain. It is not, then, only the actual natural constitution of the patient that is to be considered, but his mode of living.

hand, and a correct diagnosis on the other, with relation to practice.

Suppose two persons, of a middle age, residents in a confined part of London, addicted to full living, and what I consider as one of the marks of a very bad habit, corpulent, and of a sallowish complexion, and tinted with red vessels on the cheeks. Suppose that these persons as nearly resemble each other as possible, and that both are attacked (to carry on the argument) by inflammation of the peritonenm. In one, the symptoms may be of enteritis, a *constant* hot burning pain at the region of the navel, increased by paroxysms, but never absent, augmented and rendered unbearable by pressure, constant motion of the body, which is never at ease, nausea and vomiting, anxiety of countenance, bowels confined, pulse quick, perhaps hard or uncertain or variable. In the other, the symptoms may be of peritonitis; the pain less urgent, the general uneasiness and anxiety more moderate, the derangement of stomach not extending, or seldom amounting, to vomiting; the pulse quick, the bowels may be either confined or open. In these cases we have acute inflammation in two persons, whose constitutions are equal to no continuance of exertion, not to say an increase of it; because an increase for a short period many of them can bear without detriment. Is it not of advantage to name these complaints differently, that we may not for a moment lose sight of the leading feature of the disease, the seat of it? Have we not a great advantage in having it constantly before us, that there is a difference in the mode of treatment? It is true we treat diseases according to symptoms, not according to the name we bestow upon them; but if there be an argument in favour of distinguishing diseases from each other, that have a general similarity, I know of none more strong than that which rests on difference of symptoms, and a marked difference in practice. In the first case of well marked enteritis, we will suppose that we have had it in our power to ascertain, from previous illness, that the patient bears bleeding very badly, that

the abstraction of twenty-four ounces of blood is likely to bring on dropsy, or the greatest general debility, even terminating in death. In such case, what is to be the practice? Are we to allow the disease or the physician to kill the patient, or to combine the efforts of both, by applying leeches and fomentations to the belly, giving purgatives and clysters, and then attributing his death to his badness of constitution? A person in this state is precisely in the situation of a man who has sustained a serious injury of an extremity, requiring amputation. It must be done at the moment, or it never will be done. He is capable for a short time of bearing a great increase of action, but he is totally incapable of supporting it for any length of time. A person of this description, attacked in a warm climate by fever, which is not quickly cut short, almost invariably dies. Whatever is to be done must be done quickly. The patient with enteritis must be bled to the greatest extent that he can bear with safety. I consider twenty ounces taken at once, to be more efficacious than thirty ounces drawn at three periods; the effect on the constitution will be more immediate, more productive of benefit, and less permanently injurious. In the first case, there will be only loss of blood to contend with, inducing debility; in the second, both loss of blood and the effects of protracted disease; which last is in such cases by far the greater evil, inasmuch as it is generally a fatal one, from the mischief done to some organ or organs of vital importance.

The patient with peritonitis, although in danger, is yet less urgently so than he who is labouring under enteritis. The quantity of blood drawn need not exceed ten ounces; and great reliance may be placed on purgatives, especially on calomel, with opium, and blisters to the abdomen—remedies which are alike of little use in well-marked enteritis, until the inflammatory symptoms have been relieved by blood-letting.

A person with a habit of body and constitution of this kind, seems certainly to be at the full stretch of action, and

incapable of supporting an increase for any length of time; but in some there is a greater semblance of incapability than actual reality of it, and they bear disease better than could be expected. In all such cases we should look to and expect the worst, and then we can only be agreeably disappointed. When an amputation is performed on persons of such constitutions, the great attack is on the nervous system, which appears to be the least capable of bearing it. The object is to tranquillize and obtain rest; for reaction soon follows, a reaction which the system at large cannot support. It is at this period, the greatest nicety of practice, the greatest discrimination of constitution is required. The general symptoms of fever which ensue are those of synochus degenerating daily into typhus mitior, or nervosa, as it is used to be called, and ultimately in death, with every appearance in many cases of derangement of the biliary organs. In others it may even assume the appearance of typhus gravior. The termination is regarded more than the present state of the disease, the period for action is allowed to pass away unheeded, and because the patient dies, his death is unfairly attributed to the operation having been done at an improper period. In many such cases death must, I know, be the result, under any mode of treatment, but not in the proportion usually supposed. At the first moment of injury, the operation should be performed, so that the shock to the nervous system may if possible be continuous, and opium with purgatives should be administered to allay it. As soon as the reaction becomes permanent, the surgeon must bring all his stores of observation and experience forth; for an erroneous decision is pregnant with danger, either one way or other: general fever has taken place, and he must estimate the patient's powers of supporting and resisting it. The great error attending Mr. Hunter's facts, as drawn from hospital treatment, in my opinion, takes place here; cordials, stimulants, opiates are continued, instead of active purgatives and saline medicines. This state resembles the first, or commencing inflammatory stage, after concussion of the brain.

Blood-letting is generally admissible; it is urgently demanded, when the pulse becomes quick and in any degree full, and followed by an opiate it is frequently decisive. The quantity must here be moderate; sixteen ounces is a full bleeding, and twelve ounces may perhaps be sufficient to ascertain the effect. I believe physicians have lately discovered that the abstraction of blood with moderation in the early stages of synochus does not always, as was formerly supposed, hasten the approach of typhus gravior. And I can only say, that however sound the judgment, however great the knowledge the surgeon or consulting physician may have in the practice of physic, they will in such cases need them all.

In some cases of this description there will never be an opportunity or proper period for taking away blood. In some few instances cordials and opiates will be more proper throughout.

As external applications, cold ones are injurious; and if amputation be performed, the stump should rather be provoked to suppurate than otherwise.

In many persons, who have lived in warm climates, we feel perfectly sensible that their constitutions are unequal to any great exertions, although they appear in good health, and they declare themselves to be so, on inquiry being made. They are in high health, according to their own standard, but this is at best a bad one for resisting disease, or rather supporting it. When serious accidents happen to such people, the surgeon is often placed in a situation of peculiar responsibility and solicitude. An error in judgment may be fatal to his patient or to his reputation; and the former is too often sacrificed to the latter, where a consultation cannot be had to divide the weight of responsibility. The surgeon is in fact afraid to recommend the decided mode of treatment which the case appears to require, lest it should not be adopted, and be found by accident not to have been necessary; when his professional ability would be doubted, although it was perhaps never more conspicuous than in the recommendation. There can be no doubt but that some persons save their limbs contrary to the

opinion of the faculty; but in most of these cases the limbs are useless, and for one saved under such circumstances, ten persons die; we always hear of the successful cases, but never of the unfavourable ones.

An officer received, at the battle of Albuhera, a wound in the right leg, which fractured the tibia; the case was curable as far as regarded the injury, but the patient had lived in warm climates, and his constitution seemed so unequal to supporting any increase of action for the necessary time, that the propriety of amputation became a subject for serious consideration. It appeared very hard to lose a limb, that in a man of sound constitution might be saved; it was not certain that he was quite unequal to the task, and the wishes of the patient were acceded to. It was soon however seen, that neither the powers of the part, nor of the constitution, were equal to the duties imposed upon them; and again, at the desire of the patient, we complied with his wishes and removed the limb. The stump did well for three days, but then the pulse increased in frequency, whilst it rather diminished in strength; the stump began to swell and assume a white colour and doughy appearance, which I knew to be the forerunner of a fatal termination. From what this gentleman did bear, it was fair to conclude, that he would have outlived the amputation if it had been performed on the first day: but then it was operating on a speculation as to the powers of the constitution, not as to the state of injury—an estimate which can only be made by very experienced persons, and adopted by men of equally high characters.

The few remaining advocates for Mr. Hunter's opinion, who maintain, that the facts he has stated still hold good in regard to the inhabitants of London, insist, that in teaching surgery they must point out the proper practice for London. This necessity I do indeed acknowledge, if surgery were to be practised in London only, and the doctrines were true; but as I believe in neither, and on the contrary suppose, that surgery is to be taught on the great scale, as applicable to all

mankind, for the whole empire, for the universe; the practice peculiar to the metropolis (if such existed) would be simply an exception to a general rule, and which it would be less necessary for young men to know, as few of them are to practise in it; and the less that those who are to practise in it do know of it, the better it will be, in my opinion, for their patients.

When the Marquis of Anglesea received a wound at the battle of Waterloo, which rendered amputation necessary above the knee, the operation was performed about two hours after the receipt of the injury, and his Lordship was able to travel in three weeks. If he had not gone to Waterloo, but remained in London, and had unfortunately met with an accident rendering amputation necessary, it would not (according to the principles I have combated) have been proper to perform it immediately. His constitution would have been too vigorous in London, although it was not so at Waterloo!

The late General Turner was struck at the first siege of Badajos in 1812, by a shell on the left arm; I saw him about four hours after the accident, and amputated his arm at the shoulder-joint on the field of battle. He had left London about a month, and was then of a very vigorous constitution; if he had met with an accident of the same nature in London a month sooner, would the same practice, which was so completely successful, have been bad?

Captain Macgenis, whose arm I cut off after the battle of Albuhera, called upon me since, and among other civil things said, he hoped he might be under my care if he ever underwent another operation. I told him not to be too confident, for it was said, that an operation which would suit a healthy young man in the army would not suit a healthy young man who had a place in the Customs!

Lastly, it is well known that the soldiers of the Guards in London have hitherto worked at their respective trades, when off duty, and entered into the dissipations of persons of their own class. Whenever these men have crossed the channel,

and met with injuries on service which rendered amputation necessary, it has always been done at the moment and with the greatest success. If these persons had met with an accident a week before in London, rendering such an operation necessary, it could not, I presume, have been done with propriety!

If these statements be facts, and I believe they are undeniable, the advocates in London, for the theory and practice I have been combating, must tacitly admit, if they will not acknowledge, one of two things; either that the theory and practice are erroneous, or that they are unacquainted with the nature of the constitutions of all the young gentlemen and all the young healthy tradesmen about town. I have a suspicion they will rather prefer yielding the least tangible alternative.

Let us view the matter in another light. Some years ago I had an inflammatory attack on my chest, for which I was advised to lose some blood. The abstraction of twenty-four ounces relieved the pain and effected a cure. A person, with whom I was intimately allied, had at the same time an attack of the same complaint; I took from him only twelve ounces of blood, and relied more on other means, because I knew, from his mode of life and other circumstances, that his constitution would not bear a large bleeding; but if I had applied this reasoning to myself, merely because I happened to live in London, and without due consideration of the state of my constitution, it is very possible I might have been a candidate for a journey to Italy to relieve me from consumption.

I fully however admit (and I wish particularly to be understood on this point), that there are many persons in London, and in all extensive cities as well as in other places, whose system at large is so bad, that death soon follows any great exciting or depressing power acting upon it. We often see, that eating a small quantity of putrid food will produce in a person of this description symptoms which are quickly followed by death; whilst in another of more power and of a better habit, it merely causes vomiting and a little temporary derangement. In such cases, the man who would draw blood would be little

better than a fool or an empiric, and amputation in such a state must frequently be followed by death; but it should be borne in mind, that a person under such circumstances would seldom recover from any serious disease, and would never live until the second period for operating.

I am aware that some arguments may be adduced against my reasonings, from what is frequently observed to attend the contagious and endemic fevers of warm climates, which are not always best borne by persons in rude health. But these are exceptions, depending much upon the peculiar nature of the fever itself, its causes and effects, and not directly applicable to the points in question, inasmuch as the principles laid down for the treatment of inflammation and of injuries demanding amputation are equally good in these climates as in Europe, and the only difference in practice is, that, whatever treatment be adopted, it must be more actively enforced.

I have endeavoured, by the different illustrations given of the treatment of inflammation and irregular action in various kinds of constitutions, to convey my ideas on the subject; and I conceive that the following facts may be legitimately deduced from them.

1st, That a person in good health and of a sound constitution, between the age of fifteen and forty years, is the best able to resist disease, to bear the remedies necessary for its removal, and to sustain it for a longer time, under proper treatment, than any other class of persons.

2d, That although any given number of persons may be in apparent good health, and every function be regularly performed, still it may be a state of health according to their own standard, and not equal to that which is the most prevalent and the least faulty.

3d, That Mr. Hunter's explanation of the reason, why persons of sound constitution and strength of parts did not bear disease well, *viz.* that they were at the full stretch of action and could not bear an increase, is not well founded;

inasmuch as it has been shown, and will be further proved, that under proper treatment they are, on the contrary, the most capable of bearing disease, or an increase of it.

4th, That Mr. Hunter took his examples from persons of the second class of constitutions, instead of the first, and that to the treatment of these persons the bad success may be attributed, rather than to the constitution being so totally incapable of bearing or resisting disease.

It may appear presumptuous to connect the name of Mr. Hunter and the improper treatment of disease or injury together; but having brought the question fairly before the public, it is neither in my power nor my inclination to shrink from any censure that a due support of it may draw down upon me. I have resisted the propagation of THIS ONE principle of Mr. Hunter, because I believe it to be injurious to mankind. I have done so, supported by the experience of more than twenty years, during which period I have been accustomed to disease on an extensive scale, in various climates, and during the whole of the Peninsular war. If it be proved, however, from practical observation that I am in error, I shall be more willing to abandon my opinions than I am to maintain them. But until that be done, I should be unworthy of that school to which it is my greatest pride to belong; the school in which Mr. Hunter acknowledged he derived the information which enabled him to write his work on inflammation, which, united with his perseverance and genius, have obtained for him the highest place in surgical science; if I did not strenuously resist even his opinions when practical experience appears to demonstrate their error.

On these views of the constitution the basis of the treatment of gun-shot wounds is founded, and in combination with them, other inexpugnable opinions of Mr. Hunter's must never be overlooked: 1*. "That the inflammation which precedes sup-

* Page 376, quarto edition.

puration is much more violent in those cases where it appears to arise spontaneously, than when it arises from any injury done by violence. A suppuration equal in quantity to that from an amputation of the thigh, shall have been preceded by a much greater inflammation than that which is a consequence of the amputation."

"This inflammation would seem to vary somewhat in its effects, according to the exertion of that power during its progress; for, in proportion to its rapidity the cause is certainly more simple, and its termination and effects more speedy and salutary; and this idea agrees perfectly with inflammation in consequence of accidents, for there it runs through its stages more rapidly and with less inflammation: necessity appears to be the leading cause here."

When a simple gun-shot wound is received by a person of a good constitution, the necessary effect will be a certain degree of inflammation, and this may be violent or moderate according to accidental circumstances of constitution or otherwise; but whatever may be the extent of inflammation, except it run on to gangrene, it is always prone to the suppurative, passes rapidly over the adhesive stage, and proceeds in the most speedy manner to the restoration of the part to its healthy state, provided there is not a sufficient cause to prevent it in the nature of the wound itself, or in some foreign body lodging in it. According to the extent of inflammation will be that of suppuration, generally speaking; and the object to be attained is, to keep the inflammatory action within due bounds, so that the suppuration may be in proportion; for it has been observed that wounds, which have been attended by a moderate degree of inflammation and suppuration, have healed soonest, and with the least inconvenience to the patient. In these cases, adhesive inflammation, agglutinating the parts immediately around the track of the ball, seems to have put a stop to the extension of the inflammation; the change of action from the adhesive to the suppurative, which takes place, is in consequence confined to a smaller space; and the remaining

necessary actions of granulation, contraction, and cicatrization, are on an equally limited scale. In a perfectly healthy constitution, nature seems disposed to perform her part in general with the least possible difficulty; to be aware, that union by the first intention cannot alone effect a cure, that suppuration must ultimately occur; and in consequence of this intuitive knowledge, proceeds to the desired point with little hesitation on the intervening stages. It appears to me that the fundamental point to reason upon, in cases of simple gun-shot wounds in healthy persons, is this — that inflammation will ensue, will run on to suppuration, and is rather likely to be in excess than in deficiency. The practice to be pursued consonant to this opinion ought to be that, which, even from the beginning, will or may tend to reduce inflammation and the consequent suppuration; I would add, in order to express the opinion more forcibly, to prevent it as much as possible; certain, that, under every circumstance, enough will take place to maintain the necessary actions and to effect a cure.

An idea is entertained by some, that the whole track of a gun-shot wound must suppurate, and a slough of dead matter be thrown off; but this is an erroneous opinion, taken more as a necessary than a positive fact; for no one has ever seen, from a superficial or deep-seated wound of three inches in length, with two openings, a slough or sloughs of the same extent as the wound; neither can a solid substance, of the size of the opening of entrance, be passed through the wound and out at the exit of the ball, without great pain and inconvenience; and, in many cases, the actual quantity of slough and matter discharged with the dressings is by no means commensurate with the depth to which, or through which, the ball has passed. The practice, until the Peninsular war, was, in almost all cases, to apply poultices to facilitate the separation of the slough, for Mr. Hunter had favoured and inculcated this from principle; but it was soon found on service, on the great scale of warfare, to be impracticable and inexpedient, as well as not proper or beneficial to the patients;

and cold water was adopted in their stead*; and, in very many cases, lint and sticking-plaister without the assistance of either.

In discussing a surgical point of practice abstractedly, or divested of all questions of expediency or practicability, it is proper to refer only to the fact, whether, on a fair trial, one mode has been found to answer better than another; and if it be found to be so, that is the method to be laid down as the practical rule, and all others are exceptions under particular circumstances. On a fair investigation, then, by repeated trials, I have no hesitation in saying, that the advantage is decidedly in favour of the treatment by the application of cold water; the inflammation is, in some instances, materially prevented, in many greatly controlled, and, in almost all, very much subdued by it; whilst the suppurative process is not impeded in the generality of cases, in a degree sufficient to interrupt the subsequent one of granulation. In all simple cases of gun-shot wounds, *id est*, flesh wounds, in persons of a healthy constitution, a piece of lint which has been dipt in oil, or on which some ointment has been spread, is the best application at first, to prevent irritation, with two slips of adhesive plaister, placed across, to retain it in its situation. A compress, or some folds of linen wetted with cold water, is then to be applied over it, and kept constantly wet and cold, even by the use of ice, if it can be obtained, and is found comfortable to the feelings of the patient. A roller is of no use, except to prevent the compress from changing its position during sleep, and is, therefore, at that period useful; but as a surgical application it is useless, if not positively injurious, because it binds a part which ought, to a certain extent, to swell, and by pressure causes irritation. Rollers ought not to be applied surgically until after some days have elapsed, and it is inexpedient to employ them in the field of battle, even if they were useful, except where some parts are to be kept in position; because when

* See the case of Lieut.-col. Creagh, page 21.

they are applied in the first instance, they soon become stiff and bloody, are for the most part cut, and are seldom preserved after the first dressing, so as to become useful at the period when the surgical application of a roller is indispensable. I have never yet seen, under any circumstances, from the first battles of Rolica and Vimiera in Portugal until the last at Toulouse in France, a superabundance, not to say a sufficiency, of rollers for the ulterior dressings of the complicated cases; and, as they are unnecessary at first, in a surgical point of view, present appearances are not to be attended to, at the expense of subsequent advantage.

The first dressing need not be removed under this plan for two, three, or four days, as may be found convenient to the surgeon. If dry lint is applied, which application will be most *convenient* in the first instance on the field of battle, it should be moistened in an *hospital* with warm water; in private life, an evaporating poultice* may be applied, for the same purpose of facilitating its removal: the reason of this difference is, that a poultice should never be seen in an hospital, unless it is absolutely necessary. It should never be applied, unless no other application will do as well; for, when once poultices become prevailing applications in an hospital, they serve to cover all kinds of negligence. I consider a poultice, applied to a compound fracture or an injured joint, to be the precursor of amputation, the cloak for previous or present negligence; and this opinion I may, I believe, venture to say has not been formed lightly, but on as great a degree of observation as has fallen to the lot of most men, either in the navy or army. It so happened, that in the greater number of our serious conflicts, I had a charge in the field, and a principal one of the same men afterwards in hospital, and, therefore, had due opportunities of making a proper estimate on

* An evaporating poultice is made by crumbling some stale bread into a basin, and pouring boiling water upon it. The basin is then to be turned over on a plate, and the water allowed to drain off, when the poultice is ready for use.

this point. At the last battle of the Peninsular war, *viz.* that of Toulouse in France, the *practical* arrangement of the hospitals was entirely under my direction, and the great facilities afforded to us, enabled me to carry into execution every opinion I entertained from previous occurrences. On this point I gave a positive order to all the hospitals in the town, which I daily visited, that in no instance was a poultice to be applied to any wound without a specific reason; and then, not that a poultice was a good thing in such cases, but that the particular one in question seemed to demand such treatment; and in regard to injuries of joints and compound fractures, they were never applied without the same attention, and seldom without my personal concurrence. Indeed, I should not do justice to the gentlemen employed, if I did not explicitly declare the obligation I was under to them on that occasion, and the sense I now entertain of their friendship, for there was not one who did not fully enter into my views; there is not one of them whose friendship I do not now enjoy; and as to the result, Sir James M'Grigor, now Director General of the Medical Department of the Army, permits me to say, that, on no occasion, has the success attending the treatment of these particular cases been greater.

The predilection for poultices has arisen from their good effects in promoting suppuration in spontaneous inflammations terminating in abscess; and it was very natural to suppose, that, if a poultice hastened the formation of matter in an abscess, it would in the same manner hasten the suppurative process in a gun-shot wound, in which the due formation of matter, and the separation of the slough, seemed the most essential points. If the formation of matter and the separation of sloughs were all that is required, a poultice would be the best application, and the two kinds of inflammation would be on a par, and the treatment alike; but this is not the case, and it seems to me to be an incalculable oversight to suppose that it was so, after Mr. Hunter had pointed out, as he has done, the very material difference between them, *viz.*

that the inflammation preceding the suppuration after injury is never so great as when it occurs spontaneously; and that after injury there is less delay in the processes immediately preceding suppuration. The two states of inflammation are by no means under the same circumstances. In the spontaneous inflammation, which is about to form an abscess, the adhesive state is often long and always much more extensive, the quantum of inflammation and of its phenomena is greater, the matter when formed is contained in a sac, and will have (unless it be deep seated) no communication external to it; the more perfect the suppuration, the more readily will the mischief cease, and the part almost heal without the processes of granulation and cicatrization. The formation of matter cannot be prevented, and any attempt at it, after it has been found useless, only does mischief by interrupting the process. After injury, the inflammation, although tending to the suppurative, is not necessarily extensive; the parts around are not thickened to the same extent as the formation of an abscess; the quantum of inflammation, as known by its four great phenomena, pain, heat, redness, and swelling, is often trifling; the matter, when formed, is immediately discharged; there is not the same necessity for the formation of the walls of an abscess, and every part is disposed to healthy action, which is not always the case in spontaneous inflammation. Admitting even that the inflammation is still the same, it will, I trust, be conceded, that the state is different, and ought be treated differently. I consider the inflammation of a simple gun-shot wound to be like the inflammation of a part of importance, in which we always try to have as little suppuration as possible, and we ought to endeavour to effect this by the same means, proportioned to the urgency of the case.

The object of a poultice is to keep a part warm, moist, soft, and to relax it as much as possible, and thereby to augment the facility for the formation of matter, which it generally does; but repeated poulticing often keeps up the irritation on a part through that very relaxation, and renders it to-

tally unequal to support the subsequent necessary operations. It causes the suppuration in an open ulcer to be more profuse, the granulations weak, and lays the foundation for extensive sinuses.

Cold water is, in my opinion, the proper application to gun-shot wounds in persons of a healthy habit of body; it may be applied in many people during the whole progress of the cure with the best effect; and, where it is admissible, it ought to be constantly used, unless in those cases in which simple compress and bandage may be considered sufficient.

Cold water is not however an infallible, or even always an advantageous remedy; there are many persons with whom cold applications do not agree; there are more with whom they disagree after a certain period, and in either case they should not be persisted in. Cold does no good in any stage of inflammation, when the sensation accruing from the first application of it is not agreeable to the feelings of the patient; when, in fact, it does not give relief; for if it produces a sensation of shivering, or an uncomfortable feeling of any kind, with stiffness of the part, it is doing harm, and a change to the genial sensation of warmth will not only prove more agreeable, but more advantageous. This occurs in general about the period when suppuration has taken place; and cold in such cases is preventing the full effect of the action, which warmth encourages. Fomentations are then proper; and if a poultice be preferred for convenience by day or by night, an evaporating one of bread will be found sufficient. In the spring of the year, the marsh-mallow makes an excellent poultice, and so do turnips, gourds, carrots, &c. independently of oatmeal, linseed meal, Indian meal, or other farinaceous substances. In all those cases where a poultice is resorted to, as much attention is to be paid to the period of removing, as of applying it. It is used to alleviate pain, stiffness, swelling, the uneasiness arising from cold, and to encourage the commencing or interrupted action of the vessels towards the formation of matter; and as soon as the effect intended has been

gained, the poultice should be abandoned, and recourse again had to cold water, with compress and bandage. A very good instance of this was seen in the case of the son of the late Sir Richard Croft, who was wounded in the foot at Waterloo. The ball could not be found, although an opening had been made where it was supposed to be, and poultices had been applied to relieve pain and encourage suppuration. In this state, at the end of three weeks, he came entirely under my care, on his way from Brussels by Antwerp and the Scheldt to London, and it was my intention to have delivered him over to his father without interference, which I did not think necessary. Being detained, however, a few days at Flushing by contrary winds, I saw that he was uneasy and irritable, both generally as well as locally, that the suppuration was great for the size of the wound, and the parts becoming weak, in consequence of the delay. I changed the poultice for cold water, a compress and bandage; he felt immediate relief, and from that moment his wound rapidly proceeded to a cure.

The great errors in the use of poultices are, that they are often applied with no precise view, that they prevent more active measures being taken, and that by being continued too long they do a great deal of mischief, weakening the parts, promoting profuse suppurations and the formation of sinuses. It may be argued, that the abuse of a remedy is not a sufficient cause for its abandonment, and it is incontrovertibly true; but when the abuse cannot be avoided, it comes precisely to the same thing, and the rule I have laid down will be found practically the best; for in every instance in which I have seen any given number of men treated by poultices, and an equal number without them, the latter have always been in the best state. An error may also be committed in the use of cold applications, by making them too general, which causes the patient to take cold, and frequently to suffer from inflammatory affections. The parts

only which are injured, and those in their immediate vicinity, are to be wetted, and the rest of the body or extremity should be kept perfectly dry. It may be remarked, that it is seldom expedient to apply cold to the trunk of the body; for if the wounds be simple they do not require it; and if any viscus be affected or cavity opened into, the practice must be otherwise so decided as to render the aid of wet cloths of little importance. In injuries of the head it is the reverse.

When the sloughs have separated, or, what is more commonly the case, when the parts begin to granulate, a compress and bandage will complete the cure, which in simple cases takes place within the first six weeks. A great number are always cured within the first four, and in these cases bleeding is never thought of. Purgatives are occasionally administered, and abstinence is an excellent remedy; but bleeding, purgatives, occasional emetics, and starvation, are remedies of great importance, if the patients be irregular in their personal habits, or the inflammatory symptoms run high.

In wounds of muscular parts, inflammation comes on from twelve to twenty-four hours after the injury, and the vicinity of the wound becomes more sensible to the touch, with a little swelling, and increase of discoloration. A reddish serous fluid is discharged, and the limb becomes more stiff and incapable of motion, from its causing an increase of pain. These symptoms are gradually augmented on or about the third day, the inflammation surrounding the wound is better marked, the discharge is altered, being thicker; the action of the absorbents on the edges of the wound may be observed; and on the fourth or fifth the line of separation between the dead and the living parts will be very evident. The wound will now discharge purulent matter mixed with other fluids, which gradually diminish as the natural healthy actions take place. The inside of the wound, as the process of separation proceeds, changes from the blackish red colour to a brownish yellow, surrounded by a little good pus. On the

fifth and sixth days the outer edge of the separating slough is distinctly marked, and begins to be displaced; the surrounding inflammation extends to some distance, the parts are more painful and sensible to the touch, the discharge is more purulent, but not great in quantity. On the eighth or ninth day, the slough is in most cases separated from the edges of the track of the ball, and hanging in the mouth of the wound, although it cannot yet be disengaged; the discharge increases, the wound becomes less painful to the patient, although frequently more sensible when touched. If there be two openings, the exit of the ball or the depending opening is in general much the cleanest, being often in a fair granulating state before the entrance of the ball is free from slough. If the inflammation has been smart, the limb is at this time a little swelled for some distance around, coagulable lymph and serum are thrown out into the cellular membrane, the redness of inflammation now diminishes, the sloughs are discharged, together with any little extraneous substances which may be in the wound, and there is oftentimes a slight bleeding if the irritable granulations are roughly treated. The limb on the twelfth, and even fifteenth day, retains the appearance of yellowness and discoloration which ensues from a bruise, and which continues a few days longer. The sloughs do not sometimes separate until this period; and in persons slow to action, not even until a later one. The wound now contracts, the centre of the track first closes, and it is no longer pervious. The lower opening soon heals, whilst that made by the entrance of the ball continues to discharge for some time; and towards the end of six weeks, or sometimes two months, finally heals with a depression and cicatrix, marking distinctly the injury that has been received.

This is the usual course of a favourable wound of muscular parts in persons of a healthy constitution, which will almost work its own cure without any surgical aid, the system sympathizing but little with the injury. There is scarcely any fever, loss of appetite, heat of skin, or restless-

ness, very often so little that it is impossible to restrain either officers or soldiers within the bounds necessary to keep every thing in a quiescent state. It is in such cases as are here described, that the practice I have recommended ought not to be departed from.

But this favourable and tranquil proceeding is not to be expected in every instance. The state of constitution, the difficulties and distresses of military warfare, exposure to the inclemency of the weather, or the imprudence of individuals, will bring on a train of serious symptoms, in wounds apparently of the same nature. After the first three days, the symptoms gradually increase, the swelling is much augmented, the redness spreads far from the edges of the wound, the pain becomes severe and constant. The wound remains dry, stiff, painful, with glistening edges. The sensibility is now much increased. The system sympathizes, the skin becomes hot and dry, the tongue loaded, the head aches, the patient is restless and uneasy, the pulse full and quick, there is fever of the inflammatory kind. The swelling of the part increases from the deposition of lymph and serum in the cellular membrane to a considerable extent above and below the wound, which is in a state of high inflammation; and, instead of being entirely superficial or confined to the immediate track of the ball, is spreading wide and deep in the muscular parts of the limb. The wound itself can hardly bear to be touched, it discharges but little, and the sloughs separate slowly. If the inflammation be manageable, matter begins to be secreted copiously, not only in the track of the wound, but in the surrounding parts; sinuses form in the course of the muscles or under the fascia; considerable surgical treatment is necessary, and the cure is protracted from three to four, and even six months, and is often attended for a longer period with lameness from contraction of the muscles or adhesions of the cellular membrane. The parts, from having been so long in a state of inflammation, are much weaker; and if the injury has been in the lower extremity, the leg and foot swell on

any exertion, which cannot be performed without pain and inconvenience for a considerable time; the inflammation being readily brought on, and the weak parts forming the cicatrix giving way by ulceration, and forming again a very troublesome sore.

The treatment in a case of this kind is of the same nature as the other, but it must be more active. The patient must be bled, vomited, purged, kept in the recumbent position, and cold applied so long as it shall be found agreeable to his feelings; when that ceases to be the case, and not till then, fomentations ought to be resorted to; but they are to be abandoned the instant the inflammation is subdued and suppuration well established. The feeling of the patient will determine the period, and it is better to begin a day too soon than one too late. If the inflammation be superficial, leeches will not be of the same utility as when it is deep seated; but then they must be applied in much greater numbers than are usually recommended. The roller and graduated compresses are the best means of cure in the subsequent stages, with change of air, and friction to the whole extremity, which alone, when early and well applied, will often save months of tedious treatment. If the limb becomes contracted, and the cellular membrane thickened, it is only by friction, or pressure with the thumb and fingers (shampooing), that it can be restored to its natural motion.

A superficial wound in muscular parts by cannon-shot or shell requires little or no change of treatment, save that attention must be paid in a greater degree that due motion be given to the part in the latter stages, so that the new skin formed may not impede by its contraction the natural action of the limb.

If the ball should have penetrated without making an exit, or have carried in with it any extraneous substances, the surgeon must, if possible, ascertain its exact situation, and remove it and any foreign bodies which may be lodged; indeed, if there be time, every wound should be examined

so strictly as to enable the surgeon to satisfy himself that nothing has lodged. This is less necessary where there are two corresponding openings evidently belonging to one shot; but it is imperiously demanded of the surgeon where there is one opening only, even if that be so much lacerated as to lead to the suspicion of its being a rent from a piece of a shell; for it is by no means uncommon for such missiles, or a grape-shot, to lodge wholly unknown to the patient, and to be discovered by the surgeon at a subsequent period, when much time has been lost and misery endured. A soldier, during the siege of Badajos, had the misfortune to be near a shell at the moment of its bursting, and was so much mangled as to render it necessary to remove one leg, an arm, and a testicle (a part of the penis and scrotum being lost), by which he became so faint that I could not proceed with the examination of the flesh wounds received at the same time. In one of those in the back part of the thigh and buttock a large piece of shell was lodged, and kept up considerable irritation until it was removed. The man recovered, and has a pension of 2s. 9d. a day.

An officer had a finger shot off, as it was supposed, without the ball doing farther mischief, and the torn surface was made smooth by operation and dressed accordingly; but in a few days it was perceived that greater inflammation had taken place than is usual on such occasions, and on examination it appeared that the ball had passed up under the palmar aponeurosis, and had lodged in the wrist, from whence it was extracted. Too much attention cannot be paid to this circumstance at the moment of injury, and I have already insisted sufficiently on the necessity of position, and other matters, in enabling us to ascertain the course and situation of the ball or foreign body. See page 17. This practice has been duly appreciated from the earliest ages of surgery, before gun-shot wounds were known, but when the use of slings and other instruments of missile warfare caused the lodgment of extraneous substances. It is not then of modern origin, but is as old

a precept as any in surgery. Hippocrates, Celsus, and Galen, especially recommended it; and the fathers of military surgery in France and England, Paré and Wiseman, have strenuously insisted upon it.

The advantage of attending to position and the situation of the wounded person, in regard to his antagonist, at the moment of injury, is farther illustrated in a case treated, a few days after the battle of Toulouse, by Dr. Chermside, of the 10th Royal Hussars, then Assistant Surgeon of the 7th Hussars. The soldier, a private of the 61st regiment, received a musket-ball a little below the head of the fibula, which lodged, and he was taken prisoner. Three incisions were made on the inside of the leg, in search of the ball, but in vain, whilst in the hands of the French. Dr. C. having ascertained that the ball was fired from above him, whilst his leg was bent, conceived its course must be obliquely downwards, and near the inner ankle, whence it was successfully extracted. The ball had struck the bone, and its shape was considerably jagged and flattened.

Attention to the remarks that have already been made on this subject, may enable the practitioner to attain a tolerable knowledge of the nature of the injury; but the course of balls being frequently extensive, it is impossible to follow them with any instrument. In the extremities, when it is supposed that the ball is lodged at any given distance, the finger is the best sound, both for ascertaining the direction the ball has taken, and the state of the surrounding parts; and where the finger cannot reach, and circumstances render it advisable, a metallic, or firm elastic bougie, or long silver probe, may be used with some little advantage.

The finger should be gently introduced in the course of the ball, to its utmost extent, in every wound which it is necessary to examine; and in parts connected with life, or liable to be seriously injured, it is the only sound that is admissible. Whilst this examination is taking place, the hand of the surgeon should be carefully pressed upon the part

opposite where the ball may be expected to lie, by which it may perhaps be brought within reach of the finger, whereas, by the want of this precaution, it may be missed by a very trifling distance. Whilst the finger is in the wound, the limb may be thrown as nearly as possible into that action which was about to be performed on the receipt of the injury, when the contraction of the muscles, and the relative change of parts, will more readily allow the course of the ball to be followed; if this should fail, attention should be paid to the various actions of the limb, the attendant symptoms arising from parts affected, and what may be called the general anatomy of the whole circle of injury. A muscle, in the act of contraction, may oppose an obstacle to the passsage of an instrument in the direction the ball has taken, and especially if it should have passed between tendons or surfaces loosely connected by cellular membrane; as by the side of, or between the great bloodvessels, which by their elasticity may make way for the ball, and yet impede the progress of the sound. When the ball is ascertained to have passed beyond the reach of the finger, the opposite side of the limb should be carefully examined, and pressure made upon the wounded side, when it will probably be found more or less deeply seated. If the ball should not be discoverable by the finger in the wound, or by pressure on the opposite side, the surgeon should consider every symptom and every part of anatomy connected with the wound, before he decides on leaving the ball to the wise operations of nature, or to proceed to further attempts with longer sounds of other descriptions. Upon this point there has been much discussion, which naturally includes the question of extraction in general; some having decided upon leaving balls unmolested when there was a difficulty in extracting them; others, upon extracting them, except when it was attended with particular danger.

The older surgeons, less acquainted with anatomy than those of a later period, were more cautious in the means employed for the extraction of balls than their successors; and

although they were equally desirous of removing them, and considered their extraction as a necessary part of the cure, they did not resort to extensive or deep incisions, but rather depended upon the dexterous use of sounds to discover the situation of balls, and of various kinds of dilating and extracting instruments for their removal; and only enlarging the wounds when they could not obtain their object without it. This even they did not do, unless they had discovered the ball, and were certain of removing it, considering it rather a personal disgrace to have made their incision without effect, and thereby increasing the sufferings of their patients. The effects of this forcible dilatation, in all cases where balls were lodged, were most sensibly felt, the sufferings of the patients were greatly augmented, and the symptoms that followed these efforts when successful, or otherwise, were extremely severe.

Ambrose Paré, whose surgical career should be the object of imitation of every military surgeon, appears first to have introduced the practice of searching for balls, or other extraneous substances, by means of large and deep incisions; and this practice, in the hands of some of his successors on the continent, having been found successful in complicated wounds, and less dangerous in simple ones, than the method of dilating by force, by means of forceps or other instruments, was gradually adopted in all cases; and not only in such as required them to make room for the introduction of instruments, but in those in which the ball had passed out, and rendered it unnecessary.

In England the practice of dilatation was not carried to so great an extent. Wiseman, whose surgery of gun-shot wounds is very correct, acknowledges in that part of his treatise on the extraction of bullets, that they often lie quiet in the body without producing any mischief; but that in general they are very troublesome, forming sinuses attended with much pain and inconvenience; and in consequence recommends their extraction, whenever it be possible by incision, without injuring parts of importance. When in muscular parts

he admits, that the ball may be sometimes permitted to remain until after suppuration has taken place, but he rather wishes that all considerable wounds, appearing likely to form fistulæ, should be enlarged, in order to give free vent to the matter; and when this is not sufficient, he recommends a counter-opening, with the wise precaution of previously trying a change of position and bandage.

It is proper to mention, that before and after the time of Paré, surgeons supposed that gun-shot wounds were poisoned, from the pain, heat, and other usual phenomena of inflammation which ensued; as well as the blackness, and the evil consequences arising from the burning irons, hot oils, and scarifications they employed to get rid of the poison, not to include the gangrene common to hospitals, crowded and conducted as they were in former times. When Paré proved that gun-shot wounds were not poisoned, and recommended a milder and more successful practice, the irons and hot oils were abandoned, but scarifications continued to be used, not only because it had been customary to use them, but because the theories of that period supposed a stretching of the nervous filaments, causing the febrile and inflammatory symptoms which ensued; and it was supposed, that these would disappear after the cause had been removed: hence the scarifications in every direction.

This practice was continued with little alteration until the time of Mr. Hunter. We find that the Baron Percy, in his Manuel de Chirurgien d'Armée, Paris, 1792, strongly recommends it. He says, page 186, seconde partie, "The first indication of cure is to change the nature of the wound as nearly as possible into an incised one. It ought to suppurate in all its extent; but it is useful to obtain beforehand the discharge of the fluids which are retained in the extremities of the bruised vessels; this can only be accomplished by proper incisions and scarifications, by means of which many disagreeable accidents are prevented, such as tumefactions, abscesses, and sinuses, which are the cause of numerous counter-

openings. These incisions must, however, be scientifically made.

"It is a gross deception to suppose that the indication is fulfilled by making large incisions at the entrance and the exit of the ball; they are, on the contrary, very dangerous when made without due precaution: for in dividing too much integument, an opening is made for the protrusion of the muscles beneath, and they do not prevent or remove the tumefaction of the parts. The inflammation makes progress, fever arises accompanied by delirium, and the parts slough or become gangrenous, unless the formation of abscesses, which are unfortunately salutary in such cases, brings relief. To scarify with precision, the finger ought first to be introduced into the wound, and passing the knife on it, the wound should be enlarged from within outwards, as far as may be considered necessary, which prevents the possibility of the skin only being divided, and thereby permitting the muscles to protrude. The more interior parts of the track of the ball should then be scarified in succession. The intention is to remove by local bleeding the loaded state of the vessels; and if there be any parts within, which appear to bind down, or to act like a stricture on the rest, they are to be divided on the finger. When the muscles are covered by aponeuroses, they must always be scarified in different directions, to prevent the strangulation which would ensue from the swelling of the part.

"When a wound has been well scarified in the manner directed, so that a finger can be easily introduced at each orifice, and made to meet, it becomes as it were a simple wound, which will readily heal with ordinary treatment. Sometimes the thickness of the part, as well as the immediate vicinity of some important nerve or vessel, will prevent our proceeding in this manner; and it is in these cases that the anatomical knowledge of the surgeon will enable him to finish with ease and safety, what another could only begin with difficulty and danger."

Mr. Hunter, who wrote about the same period, expresses

himself in a far different manner on the same subject, and I cannot do better than oppose the principles of one man to those of the other. He says, page 532, quarto edition, "If a ball pass through a fleshy part, where it can hurt no bone in its way, such as the thick of the thigh, I own, in such a simple wound, I see no reason for opening it; because I see no purpose that can be answered by it, except the shortening of the depth of the wound made by the ball, which can be productive of no benefit. If the ball does not pass through, and is not to be found, opening can be of as little service. If the opening in the skin should be objected to, as being too small, and thereby forming an obstruction to the exit of the slough, &c., I think that in general it is not; for the skin is kept open by its own elasticity, as we see in all wounds; this elasticity, muscles and many other parts have not; and, in general, the opening made by a ball is much larger than those made by pointed instruments; for I have already observed, that there is often a piece of the skin carried in before the ball, especially if it passed with considerable velocity, besides the circular slough; so that there is really in such cases a greater loss of substance; therefore whatever matter or extraneous body there is, when it comes to the skin, it will find a free passage out. Nor does the wound in the skin in general heal sooner than the bottom; and, indeed, in many cases not so soon, because the skin is generally the part that has suffered most.

"However, this is not an absolute rule, for the skin sometimes heals first; but I have found this to be the case as often where opening had been made, as in those where there had not, and this will depend upon circumstances or peculiarities; such as the bottom being at a considerable distance, with extraneous bodies, and having no disposition to heal, tending to a fistula: and I have observed in those cases, that the wound or opening made by the surgeon generally skinned to a small hole before the bottom of the wound was closed, which brings it to the state it would have been in, if it had not been dilated

at all, especially if there are extraneous bodies still remaining; for an extraneous body causes and keeps up the secretion of matter, or rather keeps up the disease at the bottom of the wound, by which means the healing disposition of its mouth is in some degree destroyed.

" Let me state a case of this last description. Suppose a wound made with a ball; that wound (from circumstances) is not to heal in six months, because the extraneous bodies, &c. cannot be extracted or work out sooner; or some other circumstance prevents the cure in a shorter time: open that wound as freely as may be thought necessary, I will engage that it will be in a month's time in the same state with a similar wound that has not been opened, so that the whole advantage (if there is any) must be before it comes to this state; but it is very seldom that any thing of consequence can be done in that time, because the extraneous bodies do not come out at first so readily as they do at last, for the inflammation and tumefaction, which extends beyond that very opening, generally keeps them in; and if the wound is opened on their account at first, it ought to be continued to the very last. Upon the same principle, opening on account of extraneous bodies at first cannot be of so much service as opening some time after; for the suppuration, with its leading causes, *viz.* inflammation and sloughing all along the passage of the ball, makes the passage itself much more determined and more easily followed; for the want of which, few extraneous bodies are ever extracted at the beginning, excepting what are superficial, small, and loose.

"If the extraneous bodies are broken bones, it seldom happens that they are entirely detached, and therefore must loosen before they can come away; also the bones in many cases are rendered dead, either by the blow, or by being exposed, which must exfoliate, and this requires some time, for in gun-shot wounds, where bones are either bruised or broke, there is most commonly an exfoliation, because some part of the bone is deadened, similar to the slough in the soft parts.

" A reason given for opening gun-shot wounds is, that it

takes off the tension arising from the inflammation, and gives the part liberty; this would be very good practice if tension or inflammation were not a consequence of wounds; or it would be very good practice if they could prove, that the effects from dilating a part that was already wounded were very different, if not quite the reverse of those of the first wound; but as this must always be considered as an extension of the first mischief, we must suppose it to produce an increase of the effects arising from that mischief; therefore, this practice is contradictory to common sense and common observation.

"They are principally the compound wounds that require surgical operations, and certain precautions are necessary with regard to them, which I shall here lay down.

"As the dilatation of gun-shot wounds is a violence, it will be necessary to consider well what relief can be given to the parts or patient by such an operation; and whether, without it, more mischief would ensue; it should also be considered, what is the proper time for dilating.

"But it will be almost impossible to state what wound ought, and what ought not to be opened; this must always be determined by the surgeon, after he is acquainted with the true state of the case and the general principles; but from what has been already said, we may in some measure judge what those wounds are that should be opened, in order to produce immediate relief, or to assist in the cure: we must have some other views than those objected to, we must see plainly something to be done for the relief of the patient by this opening, which cannot be procured without it, and if not procured, that the part cannot heal, or that the patient must lose his life.

"The practice to be recommended here will be exactly similar to the common practice of surgery, without paying any attention to the cause as a gun-shot wound."

In another place he says, "It is contrary to all the rules of surgery, founded on our knowledge of the animal economy, to enlarge wounds simply as wounds; no wound, let it be ever so small, should be made larger, excepting when preparatory

to something else, which will imply a complicated wound, and which is to be treated accordingly; it should not be opened because it is a wound, but because there is something necessary to be done, which cannot be executed unless the wound is enlarged."

Mr. Hunter wrote from his knowledge of principles, unbiassed by any particular theory, and from having had some opportunities of practice; and the experience acquired during the Peninsular war, by army surgeons, proves that his opinions were correct as far as they relate to wounds in muscular parts; but he at the same time laid the foundation for a practice equally, if not more, dangerous, *viz.* that of neglecting dilatation under circumstances in which it was absolutely necessary: a practice which this great man by no means had in contemplation when he wrote, nor which he could foresee was likely to follow from his work.

Mr. John Bell has quoted these same opinions of Mr. Hunter, in the third edition of his Discourses on Wounds, 1812; and endeavoured to refute them, by bringing forward the old arguments used on this occasion. This was excusable in the two first editions, because Mr. J. Bell had had no practice of his own, and little opportunity of inquiring into that of others; but it is not so in the third, because at that period the war in the Peninsula had afforded many opportunities of judging to which the preference should be given, and it was Mr. Bell's duty to have ascertained the fact before he wrote, and taught a practice, which all those who knew any thing about the matter had abandoned.

The cause of so much error on the part of Mr. John Bell and others who have followed him was, that they conceived the wound must inflame (in which opinion they were right); and that the whole limb must inflame also, in which they were totally wrong; having reasoned from theory, probably on an individual case, and not from actual observation made on many; for I have shown, that wounds, passing deep through muscular parts, do not usually cause inflammation in the

manner supposed, and that it may in general be subdued by more mild treatment than deep scarifications. As to simply dilating the mouth of the wound, as it is termed, by cutting through the skin, it is too absurd to argue upon, and those who say it gives no pain have only to make the experiment on themselves to be thoroughly convinced of their error. That the *eschars*, as they are termed, were formerly very large, cannot be doubted, because we find it so repeatedly stated to be the case by different authors; but as they are not so now, we can only suppose they were caused in the greater number of instances by their own injudicious proceedings; and that, whilst they were labouring hard to prevent mischief, they were actually giving rise to it.

The practice during the Peninsular war was, never to dilate without a precise object in view, which might render an additional opening necessary. This opening must always, consistently with this principle, have been carried through the fascia of a limb, and was truly a dilatation, whilst those incisions which were formerly made through the skin, or indentations in the edges of the fascia, were entirely abandoned. A wound was never then dilated, neither ought it to be dilated, because it may at a more distant period become necessary. The necessity must first be seen, when the operation follows of course. I know not a stronger instance exemplifying this, than that of a wounded artery, which all admit to be a fair case for dilatation. Suppose, then, that a man be brought for assistance with a wound through the thigh, in the immediate vicinity of the femoral artery, and which, he says, bled considerably at the moment of injury, but which had ceased; is the surgeon warranted in cutting down upon the artery and putting ligatures upon it on suspicion? I believe every man in his senses will answer, no; the surgeon ought to take the precaution of applying a tourniquet loosely on the limb, and of placing the man in a situation where he can receive constant attention in case of need; but he is not authorized to proceed to any operation unless another bleeding demonstrates the injury, and the necessity for

relieving it. By the same reasoning, incisions are not to be made into the thigh on the speculation that they may be hereafter required.

If the confusion which has enveloped this subject be removed, and bleeding arteries, broken bones, and the lodgment of extraneous matter, be admitted to be legitimate causes for dilating wounds, as I believe Mr. Hunter and all other reasonable men have admitted, the discussion and the arguments in favour of primary dilatation, in other cases, must fall to the ground.

In stating this, I by no means wish to undervalue incisions, when made at proper periods; but I wish to restrict them to such periods, and when the necessity for them has become obvious. Mr. John Bell has supported his opinions by cases in which dilatation was necessary, in consequence of general inflammation of the limb beneath the fascia. He has improperly considered these cases as examples of a general rule, instead of being exceptions to it; but taking, for the sake of argument, his strongest case, let us see what it will prove. Page 197, octavo edition, he says, "there is one case which stands out very prominent from all the rest, where the fascia was four times divided, always with perfect relief; but always, as the fascia healed, the contraction of the arm, the spasmodic disease of the whole system, the restless nights, fearful dreams, pain, fever, and weakness returned; till at last, by a random stroke, rather than by any well-conceived design of the surgeon, the fascia was fairly cut across, at the place where it is braced down by its connection with the long tendon of the biceps muscle, and then only, *viz.* at the fourth incision, the patient was entirely released. 'Now,' says she, 'you have indeed cut the cord which bound my arm,' and she tossed her arm freely and with great exultation. In short, this is a case on which I would insist much; for were I to detail, at full length, the circumstances of it, these four successive operations would be found to resemble rather four regular

experiments, contrived for the very purpose of proving how dreadful the distress arising from a tense fascia is, and how sure the relief is every time that the fascia is opened; and how surely the distress returns every time that the fascia is allowed to close; and how perfect the relief is whenever the fascia is decidedly and fairly cut across. In short, with such analogies before him, no surgeon, however averse from the dilatation of gun-shot wounds, can refuse his assent to this second rule, 'that whenever we dilate the mouth of a gun-shot wound, the incision should pass through the fascia as well as through the skin,' and that whenever the symptoms of a tight fascia come on, we should be careful to open the wound anew, and to make the fascia quite free."

In this case, in which extreme inflammation beneath the fascia took place, four incisions were made without affording perfect relief; and it is declared they were not made in the right place, or sufficiently extensive, although the state of the limb and of the system indicated the necessity for some relief being given. If, then, they were not made in the right place, or to a sufficient extent, when the state of the limb pointed out the mischief, was it likely they would have been more advantageously made before any such indication occurred? The answer must be, certainly not. But it may be said, that if they had been properly made they might have prevented the mischief altogether, which is merely begging the question, for in hundreds of similar cases no such mischief has taken place when no incisions have been made. At last the surgeon, by a *random* stroke, cut the aponeurosis of the biceps muscle, and the patient became instantly at ease, which part of the story is peculiarly insisted upon by him and others; but if this is to be applied to practice and imitated, I know not any other inference that can be drawn from it, and whenever I have heard or known the case quoted by Mr. C. Bell I never could draw any other, but that the aponeurosis should have been cut sooner; and of course, that in similar cases of injury the surgeon should by a stroke,

equally, I believe, in surgery as *random* as the other, cut the aponeurosis of the biceps. Unless it means this, it does not bear upon the question of incising wounds immediately on the receipt of the injury, which it is intended to support. That the incision was proper at the period alluded to is demonstrated; it might have been judicious to have made it earlier: but that because a person has received an injury on the arm, which might give rise to inflammation, the aponeurosis of the biceps should be cut, is really absurd. It will be said, it is only meant that something must be cut; but in this case it appears cutting the aponeurosis alone gave permanent relief; it was that part only, then, which should have been cut, and as there could be no proper indication for this at the moment of injury, the inference I have drawn is, I apprehend, the true one; and wounds, although likely to give rise to inflammation under fasciæ, are not to be dilated at *random*, to prevent what may never occur; but when the occurrence of the inflammation shows the necessity for an operation, the surgeon will do it with precision, and not put his patient to the pain of several useless incisions, from the simple circumstance of not knowing where to cut, or what to do, unless it be that he must do something.

The error has arisen, as I have already stated, from supposing, that when a ball passes through the thigh the whole limb must inflame in all its extent and depth, which is, on the contrary, seldom the case; for it often happens, that the inflammation is very moderate, and, when the patient has been properly treated, even slight. I admit, however, that in some cases the inflammation is deep and extensive, that matter forms beneath or between the muscles, that the usual inflammation around the track of the ball has been much exceeded, and suppuration to a greater extent has taken place. Admitting this, I inquire, if it has occurred because the fascia was not divided, and the reply must be in the negative; for, if it was the cause in this case, it must have had equal influence in others, and all cases of a similar nature would become

affected in the same manner, which is not the fact. The inflammation, then, is determined principally by the state of constitution of the patient, or perhaps by some accidental circumstance in the nature of the wound; it extends between the muscles, and is fully developed, before the fascia can act by causing the pressure; for the fascia is nearly passive; it is the swelling of the limb, one of the phenomena of inflammation, which causes the pressure; in like manner as in strangulated hernia it is the swelling of the intestine which causes pressure against the edge of the ring, and the mischief which we wish to obviate. After the inflammation has taken place, it may be, and is increased, from the part being unable to swell to its full extent, and acute pain, throbbing, startings, fever, and delirium, are the consequences. These symptoms, however, only come on several days after the receipt of the injury, and require as much medical as surgical treatment; for it is quite a mistaken notion, that the surgeon has but to take up his knife, and make a large incision through the fascia, and all will be removed. The inflammation, which began before the state of the fascia interfered with it, is yet to be treated; the derangement of system constituting fever, which has taken place, may be still more dangerous than the local injury, and it will generally be so, if the patients have been subject to any endemic disease of the country, or if any peculiar kind of fever prevails. The maxim which obtains with many surgeons, that the effects will subside, if the original or exciting cause be removed, is erroneous, and more discreditable to surgery than any other with which I am acquainted; for, when diseased or irregular actions have fairly taken place, they will often continue, and run on to the destruction of the patient or part, although the exciting cause be entirely removed. One of the strongest instances of the impropriety of this maxim may be drawn from the treatment of strangulated hernia. Take, for example, a recent case of hernia, strangulated and in a state of high inflammation; relief is only to be obtained by the knife, and the operation is

successfully accomplished, *i. e.* the stricture is taken off the intestine. If the surgeon, as is sometimes the case, thinks he has done his duty, and quits his patient under the impression that nothing more than a cathartic or enema is necessary, he fails as a scientific practitioner, becomes a mere dissector, and his patient often loses his life. The part is in a state of high inflammation, and the removal of the stricture upon it only takes away one cause tending to increase the inflammation, but does little towards the diminution of that which has already taken place, provided it be to any extent. In an early stage nature may be able to act for and relieve herself after the obstruction has been removed; but in a later one, when the inflammation is fairly established, and running on towards gangrene, it is in the same state as any other common inflammation, and requires the same energetic mode of cure. When, then, I read, and have heard it said, that bleeding is of little or no use in strangulated hernia of recent origin in young robust persons, or even in others, neither before nor after the operation, I am obliged to confess with regret, that surgery is never more degraded than when it appears to be adorned with greatest splendour; that in no instance does surgery become so entirely an art as in this, where it especially deserves to be considered as a science. I have at this moment a preparation before me, in which the operation was successfully performed, but the patient was lost for want of medical treatment; and I firmly believe, that the greater number of cases which are lost without mortification taking place, are lost from the same cause; but this is not peculiar to the operation for hernia. It was very common a few years ago, after all the great operations for amputation, and in many others of equally dangerous tendency.

When, then, inflammation takes place in a wounded limb, and which will only occur after a few days, and there is every appearance of its becoming serious, blood is to be drawn generally, and cold or hot applications are to be made use of, according to the indications which have been laid down; an eme-

tic and purgative are to be administered, and nauseating doses of the antimonium tartarisatum to be prescribed, with saline draughts, or any other vehicle which may be at hand, or be considered advisable. Leeches will be found of great service; and if, on introducing the finger, the parts seem tense, or indeed whether they do or not, if the inflammation, pain, and fever run high, an incision is to be made by introducing the knife into the wound, and cutting for the space of two, three, or four inches, according to circumstances, in the course of the muscles, and carefully avoiding any parts of importance. The same should be done at the inferior or opposite opening if mischief be seriously impending, not so much on the principle of loosening the fascia, as on that of taking away blood from the part immediately affected, and of making a free opening for the evacuation of the fluids effused. This I have frequently done with the most marked success, and the propriety of the practice must be so obvious, that it is unnecessary to support it by any instances *. I wish, however, to mention, that it is no less an advantageous practice in the subsequent stages of gun-shot wounds, where sinuses form and are tardy in healing. A free incision is also very often serviceable, when parts are unhealthy, although there may not be any considerable sinus. Upon the necessity of it where bones are broken, there is no occasion to insist; and of the advantages of the practice of dilatation in such cases and stages, it is impossible to be too commendatory.

A punctured wound made with a lance or bayonet is also a contused wound; for no instrument, however sharp it may be, cuts from direct pressure, but from having a certain degree of drawing motion combined with it, a fact clearly demonstrated by the possibility of closing the hand on the edge of a well-set razor, without receiving any injury from the direct pressure made on it. When a bayonet is thrust into the body it is by direct pressure; and when to any depth, it passes

* Dr. Hennen, in his excellent work on Military Surgery, Syphilis, &c. has given a good illustration of this: see page 70, et seq.

through various textures, endowed with different qualities and sensibilities, from which circumstance the peculiarities arise which have been observed in punctured wounds. In an incised wound, if the two sides of it be brought together, they will frequently unite, because there is no obstacle in general to prevent it. In a contused superficial wound this cannot take place, for neither side is capable of taking on the necessary action; yet little mischief ensues, because, being a superficial wound, there is a sufficient facility for the discharge of any matter that may be secreted; and that matter must be secreted is a necessary consequence of union not taking place.

In a punctured wound of little depth, or only through the skin and cellular substance, it is seldom any inconvenience ensues, because the matter formed can be pressed out without difficulty, and the part heals up slowly but surely under the precaution of daily pressure; perhaps it heals in a shorter period than an incised wound of the same length and depth, which is left to the operation of nature, defended only by a piece of lint to prevent irritation. A punctured wound extending to considerable depth, labours under greater disadvantages, and generally in proportion to the smallness of the instrument, and the differences of texture through which it passes. When the instrument is large, the opening made is in proportion; and does not afford so great an obstacle to the discharge of the fluids poured out or secreted as when the opening is small; lance wounds are therefore less dangerous than those inflicted by the bayonet. When a small instrument passes deep through a fascia, it makes an opening in it, which is not increased by the natural retraction of parts, inasmuch as it is not sufficiently large to admit of it, and which opening, small as it is, may be filled or closed up by the soft cellular membrane below, which rises into it, and forms a barrier to the discharge of any matter which may be secreted beneath. If the instrument should have passed into a muscle, it is evident, that if that muscle was in a state of contraction at the moment of injury, the punctured part must be removed to a

certain distance from the direct line of the wound, when in a state of relaxtion, and vice versá: the matter secreted, and more or less must in almost every instance be secreted, cannot in either case make its escape, and all the symptoms occur of a spontaneous abscess deeply seated below a fascia. That inflammation should spread in a continuous texture is not un common; that matter when confined should give rise to great constitutional disturbance is, if possible, less so; but that this disturbance takes place without the occurrence of inflammation, or of the formation of matter, I deny; and of course conclude, that there is no peculiarity in punctured wounds, that may not be accounted for in a satisfactory manner. These effects have been attributed to injuries of nerves, but without sufficient reason; and those who have seen locked jaw follow a very simple scratch of the leg from a musket-ball, are not surprised at any symptoms of nervous agitation that may occur after punctured wounds.

The reason that these unpleasant symptoms do not often follow gun-shot wounds is, that the orifice is sufficiently large, and the track of the ball sufficiently open throughout, to allow of a free discharge of matter, and when mischief does take place, principally from constitutional causes, it is much of the same nature in both. As a punctured wound cannot be changed into an incised one by incision, and the object of it, which would be union by the first intention, cannot be effected, an incision, in the first instance, may do harm, and will often be unnecessary; for many bayonet wounds through muscular parts heal with little trouble, and it is time enough to act when assistance seems to be required. Cold water should be used at first; care should be taken not to apply a roller or compress of any kind over the wound, and the matter should be frequently pressed out. When suppuration is established, a roller should be applied above and below the wound, and an evaporating poultice upon it, if cold be found uncomfortable.

The observations I have already made on the general and local treatment of inflammation and suppuration beneath

fasciæ, apply in these cases, and do not require repetition. I may be permitted to give one caution, that whatever is done, should be done effectually.

A ball will frequently strike a bone, and lodge in it, without causing a fracture of the limb; and instances are on record, and preparations are shown, in which little inconvenience resulted from them; but these are exceptions only, and are sadly counterbalanced by the results of other analogous injuries. If a ball lodge in the head of a bone, and is not removed, it generally causes caries of the bone, disease of the joint, amputation, or death. If in the shaft of a long bone, necrosis for the most part follows, with months and years of misery. On a flat bone, caries is equally the result; and if it be surrounded by large muscles, sinuses form in varous directions, contractions of the limb take place, and the patient drags on for years careless of life, and ready to submit to any thing to obtain relief.

After the battle of Albuhera, I removed two balls which were sticking in bone; one in the ilium, close to the crest, the other in the outside of the femur; and both cases did well with little exfoliation. It was accomplished by raising them up with a sharp-pointed instrument, like a chisel; but if the ball be fairly imbedded in the bone, as it very often is in the bones of the cranium, it cannot be raised in this way, and a trephine must be applied. It may be laid down as a general rule, that a ball should never be allowed to remain in a bone; and, when on the subject of fractures, I shall give several unfortunate instances of the bad effects of allowing them to do so. This rule is not, however, entirely devoid of exceptions, as the following case will show.

Lieutenant-colonel Dumaresq, aide-de-camp to Sir John Byng, was wounded at the battle of Waterloo by a musket-ball, whilst in the act of turning round, after having made a successful charge with some advanced light infantry at the farm of Hougomont; the ball passed in through the scapula, penetrated and was lost in the chest. The symptoms of thoracic inflammation were almost irrestrainable, and he barely

escaped with life. A swelling was then discovered in the axilla, and it is now fully ascertained to be the ball, which lodged in the rib, I should suppose without destroying the periosteum, and which has formed a quantity of bony matter around it. At one time an operation for its removal was talked of, but I always dissented from such a proceeding, and he now enjoys good health, although occasionally subject to spasms in the chest.

In making incisions for the removal of balls in the vicinity of large vessels, the hand should always be unsupported, in order to prevent an accident from any sudden movement of the patient. This caution is more necessary on the field of battle, where many things may give rise to sudden alarm. At the affair of Saca Farte, near Alfaiates in Portugal, I stationed myself behind a small watch tower, and the wounded were first brought to this spot for assistance. A howitzer had also been placed upon it, being rising ground, and at the moment I was extracting a ball situated immediately over the carotid artery, the gun was fired, to the inexpressible alarm of surgeon, patient, and orderly, who wheeled in every direction. From my hand being unsupported, no mischief ensued, and the operation was afterwards completed. In many cases of this kind about the neck, where the ball has penetrated deep, and lodged, and it becomes necessary to cut down upon it in the vicinity of great vessels, or nerves, the surgeon may (when he is not very confident) make use of a flexible tube with a stilet, or even Pouteau's trocar, the stilet of which may be pushed on after the point of the tube is distinctly felt beneath the skin, at the proper place for making the incision, which can then be duly enlarged and with less danger.

It often happens, that a ball will be discovered on the opposite side of a limb through which it has nearly penetrated, but had not sufficient power to overcome the resistance and elasticity of the skin. In cases of this kind, and particularly when the ball is at the distance of an inch from the surface, it has been recommended to allow it to remain, rather than

to extract it immediately, on the supposition, that this additional opening might be the cause of a great increase of inflammation ; but this is merely a supposition, which has not been realized in practice. I have cut out a great number of balls under these circumstances, and have never found any inconvenience ensue: on the contrary, the minds of the sufferers have been much relieved by the removal of the ball, for with its retention there is always connected an idea of danger. By removing it an opening is obtained for the evacuation of any matter which may be formed in the long track of such a wound, and any other extraneous bodies are more readily extracted.

I cannot, however, help suspecting, that the direction must have been given, from the consideration of a different kind of case; we will say, for instance, where the ball has penetrated half through the thick part of the thigh, in such a direction that it cannot be readily removed by the opening at which it entered, or that, from the vicinity of the great vessels, it may be considered unadvisable to cut for it in that direction. The question then is, whether or not an incision should be made on the opposite side to the depth of three or four inches, in order to extract it? I have no hesitation in saying, that if the ball cannot be distinctly felt by the finger through the soft parts, it ought not to be cut upon; for an incision of considerable extent will be required to enable the surgeon to extract it: much pain will be caused, and higher inflammation may follow than would ensue, if the wound were left to the efforts of nature alone, by which, in a short time, the ball would be brought much nearer to the surface, and might be more safely extracted. It frequently happens, that after a few days, or weeks, a ball will be distinctly felt in a spot where the surgeon had before searched in vain for it. The wound will frequently heal up without any further trouble, the ball remaining without inconvenience in its new situation, and the patient, not being annoyed by it, does not feel disposed to submit to pain or inconvenience for its removal.

A very strong reason for the extraction of balls during the first period of treatment, if it can be safely accomplished, is, that they do not always remain harmless, but frequently give rise to distressing or harassing pains in and about the part, which often oblige the sufferer to submit to their extraction at a later period, when their removal is infinitely more difficult, and may be more dangerous, than at the moment of injury.

Nothing appears more simple than to cut out a ball which can be felt at the distance of an inch, or even half an inch below the skin; but the young surgeon often finds it more difficult than he expected, because he makes his incision too small, and cannot at all times oppose sufficient resistance to prevent the ball from retreating before the effort he makes for its expulsion forwards, either with the point or the handle of the instrument, or the forceps. The ball also requires to be cleared from the surrounding cellular substance to a greater extent than might at first be imagined, for all that seems to be required is, that a simple incision be made down to the surface of it, when it will slip out, which is not always found to be the case.

When a ball has been lodged for years, we find that a membranous kind of sac is formed around it, which shuts it in as it were from all communication with the surrounding parts; and in some instances it seems to do so, and the patient suffers no sort of inconvenience from its retention. In other instances, it frequently becomes necessary to extract a ball which has been lodged for years, when the membranous sac will often be found to adhere so strongly to the ball, that it cannot be got out without great difficulty, and sometimes not without cutting out a portion of the adhering sac. Some persons may be perhaps a little incredulous on this point; but they must bring to their recollection, that Mr. Hunter found no great difficulty in inducing the comb of a cock to adhere to a tooth, which in some of the instances was equally an inanimate body; and that nothing can withstand the testimony of facts. During the last winter I cut out two balls, which

had been lodged for several years; one from an officer of the Rifle Brigade, which had lodged under the pectoral muscle; the other from an officer of the 5th regiment, which had been lodged deeply in the parietes of the abdomen. The first was got out with difficulty, in consequence of the adhesion; Assistant-surgeon Robson of that corps was present. In the second operation I was assisted by Staff-surgeon Lindsey. The sac surrounding the ball was so close to the peritoneum, that there was some danger of injuring it, and it adhered so firmly to the ball, that, after several attempts made in vain to separate them, I was obliged, as the readiest method, to remove a portion of the sac attached to it. In this state I showed it at my evening lecture to all the gentlemen attending, and it is still in my possession. I do not mean to say that this kind of union takes place in every instance, but merely to relate a particular fact, and to state the greater difficulty attending the extraction of balls which have been lodged for years.

It often occurs that a ball lodges and cannot be found, especially where it has struck against a bone, and slanted off in a different direction; and if the ball should lodge in the cellular membrane between two muscles, it often descends by its gravity to a considerable distance, and excites a low degree of irritation, which slowly brings it to the surface, or terminates in abscess. To encourage this, poultices are generally recommended, but are not in my opinion serviceable; on the contrary, they rather appear to disturb and delay the operations of nature; and I usually confine myself to the application of flannel until sufficient indications arise to authorize an incision, when the ball will generally be found at the bottom of the abscess. Among a variety of cases of this description, that of Colonel Ross of the Rifle Brigade is sufficiently remarkable. He was wounded at the battle of Waterloo by a musket-ball, which entered at the upper part of the arm, and injured the bone. More than one surgeon had pointed out the way by which it had passed under the sca-

pula, and lodged itself in some of the muscles of the back. About a year afterwards, I extracted it close to the elbow, the ball lying at the bottom of an abscess, which was only brought near the surface by the use of flannel, and by desisting from all emollient applications.

I wish now to draw attention to a state of gun-shot wound which I have not often seen, but which is highly dangerous, infinitely more so than those I have been noticing, in which the inflammatory stage runs on to the suppurative. It will, perhaps, be best explained by a case.

After the battle of Albuhera, Mr. Curby, Assistant-surgeon of the 29th regiment, drew my attention to the case of a man as something peculiar, whom I had seen with him the day before with a shot through the thigh, and who died after a short illness the following morning. In the evening he had complained of pain, which had increased so much on the last visit as to demand particular attention, and fomentations and an opiate were ordered. The pain, it was reported, continued during the night, and in the morning early he died. The body was carried away, and no examination was made.

On the retreat of the army from Fuente Guinaldo in 1812, a smart affair took place at the convent of Saca Farte, between the advance of the French, and the cavalry and the fourth division of the British army under Sir L. Cole, to which I belonged. The wounded accompanied me to Sabugal, on the heights near which we offered battle. Among them was a man, a stout handsome soldier, who had been shot through the right thigh, the ball entering below the femoral artery, passing through and outwards close to the bone; this wound went on remarkably well for nearly a fortnight, so much so that the man had actually got up and walked about. I saw him at one o'clock, and, as he was standing, desired him to keep himself quiet; he answered, he felt quite well. In the evening, Mr. Mahoney, now Surgeon of the Fusileers, who occupied the same quarters with me, reported, that

the man was suffering some pain, and that he had ordered him an opiate and a poultice. He died early in the morning, having complained a good deal in the night, but not sufficiently to induce the orderlies to call Mr. Mahoney, until symptoms of approaching death alarmed them. I examined the limb carefully within twenty-four hours of the man's being in comparative health. On the day previous to his death, the wound looked favourably, there was little or no inflammation, the limb was soft, and he was capable of walking, and conceived himself comparatively well. Inflammation came on in the night, internally, deep, and hardly affecting the skin with redness: on dissection the thigh appeared swelled, although not particularly so, but on cutting deeply through the fascia in the course of the wound, the whole thigh seemed so stuffed, or gorged with blood, that the texture of the parts, muscular as well as cellular, was soft, and readily giving way to a moderate pressure of the fingers; I can only compare it to the appearance of a part just falling into a state of gangrene.

I lost a French prisoner precisely in the same way, after the battle of Salamanca; and Mr. Knight, late Inspector-general of the Medical Department of the Army, informs me, that at the Helder, in 1799, his attention was drawn to a case of the same nature, which terminated fatally; and, on dissection, the appearances gave him the idea of a part which had fallen, or was immediately about to fall, into a state of gangrene. It is not easy to say with precision, when a case of this description, which is so exceedingly rapid in its course, is cured, or rather prevented; I am almost certain I have lost others, and I think I have saved some. In either way the cases are very rare. After the battle of Toulouse, where the strictest attention was paid to every thing peculiar, there was not one. It would appear that this attack, which runs so rapid a course, is one of inflammation of the most acute kind, tending to gangrene: and the means of relief must be proportionably active. The indications, in an affection of this na-

ture, seem to be two; to relieve the part locally, and the system generally. The first is to be fulfilled by the application of leeches in great numbers, after an incision has been made into the part; the bleeding from which, so long as it lasts, will afford material relief. On introducing the finger into the wound, after the inflammation has begun, the part feels tense and painful, and the incision gives ease, not so much from relieving distention (for, after all, the separation of parts is trifling), but from the loss of blood drawn immediately from the seat of inflammation. General depletion is then to be resorted to; and one effectual bleeding, so as to cause syncope, will be most serviceable. I have found warm applications to the part more agreeable than cold. Where sixty or eighty leeches cannot be procured, we must rely more on general blood-letting.

I am aware that some persons may think they can see nothing different in these cases and observations from the preceding ones; if so, it arises from my manner of noticing them, not from their want of peculiarity: and when such a case is once seen to run its course, it will not make less impression on the mind of the observer than it has on mine.

I have hitherto mentioned the treatment of gun-shot wounds only as relating to a state of healthy inflammation; but the habits and constitutions of many do not admit of this taking place, and it assumes a different character, and requires a different treatment. In healthy phlegmonous inflammation, we act decidedly, to command, as it were, results. In bad habits, or where the inflammation is not healthy, exclusive of spontaneous inflammations, which may be different from either, we act according as circumstances present themselves. The phlegmonous and erysipelatous inflammations may be considered as two extremes of a scale, admitting between them of many modifications, and we find that even the true erysipelas is itself a very different disease, and requires a very different treatment, according to the state and habit of the patient,

the season of the year, especially in warm climates, and the nature of any other prevailing or epidemic disease.

Phlegmonous inflammation has been supposed principally to affect the cellular membrane, erysipelas the skin; pathologists are, however, by no means disposed of late to confine either kind of inflammation to that texture which is considered most proper to it; and we occasionally read of the erysipelatous inflammation attacking the serous and mucous membranes of the body, as well as being communicated by contiguity to the cellular texture: facts which deserve particular attention, as they lead to more decided modes of treating this complaint, which of all others, since the time of Hippocrates, Galen, and the Greek physicians, has afforded the greatest difference of opinion. The phlegmonous has been called healthy inflammation; because, whenever the restoration or repair of parts is to be accomplished, nature avails herself of this mode of performing it, and, through it, the other necessary actions are set up and completed. The erysipelatous has been called the unhealthy inflammation, because its tendency is directly the reverse, interfering with and putting a stop to all the actions which may be going on for the restoration or repair of parts, and not unfrequently causing, or terminating in the destruction of the part itself, by gangrene and sphacelus, attended by a greater degree of general debility than is compatible with the well-doing of the patient, or warranted by the extent of the inflammation. In order to contrast the two inflammations more strongly, it may be said, the phlegmonous inflammation terminates, with a few exceptions, in resolution, or suppuration; the erysipelatous, in effusion or gangrene: terminations, which are found directly opposed to those of phlegmonous inflammation, with reference either to the restoration of parts or the continuance of life. It is not surprising then, that, considering erysipelas as an unhealthy inflammation when a local complaint, and as dependent on an unhealty state of the system when an idiopathic disease, practitioners should treat it according to the ideas they happen to entertain of its nature, rather than according to the peculiar symptoms which may attend each of

its several modifications: that this disease should, in fact, be treated, in many instances, empirically rather than rationally. We find that many persons treat erysipelas by bark and acids as specific remedies, from the commencement of the complaint; but let the inflammation only be communicated to the membranes of the brain, and they direct blood to be drawn. It is true, in some other instances, the bark is continued, and the patient dies, as it is termed, incurable; but fortunately these cases are daily becoming more infrequent. Now, in the instance alluded to, if bark was an appropriate or specific remedy in erysipelas affecting the skin of the head, it ought to be equally proper when the inflammation has extended to the membranes of the brain, or it must be admitted that erysipelas is a very different disease, when affecting the skin and serous membranes of the same person and at the same time: an admission which will not be made. If we take the other side of the question, it comes precisely to the same thing. In a case, then, of this description, one of the two remedies was improper, or the patient recovers in spite of both; or, to say the least of it, one or other did no good, if it did no harm, and it is immaterial to my present argument which of the two may be considered the useless remedy.

It appears to me, that this disease has been viewed and considered by many persons on the same narrow principles as the question of the propriety of immediate amputation, in cases where an operation of that description must be the result of an injury. Most authors, who have written on it, have done so more with immediate reference to a particular kind or species of erysipelas, than to the disease generally; to that which has prevailed in their immediate neighbourhood, rather than to the country at large; or, they have given the history of some particular epidemic. In whatever manner the fact be accounted for, the discrepancy of opinion as to the treatment of erysipelas is remarkable, and can only be understood by taking enlarged views of the disease; for, if it be inquired into through one medium, one method of treatment only will be admitted. If we refer to

ancient authors, we find that Celsus recommended bleeding almost indiscriminately, whilst Galen never drew blood. Ætius placed his reliance on purgatives; Paulus Ægineta only where bleeding could not be performed. The Arabians also relied on purgatives; Ambrose Paré on both; our own countryman, Sydenham, on bleeding and refrigerants; whilst later practitioners have placed their entire confidence in cinchona as a specific. It is true that some more modern physicians have ventured to revive the practice of the ancients in certain cases; but the general feeling at present is decidedly in favour of bark as a remedy in all cases of erysipelas, and the authority of very great names is often brought by students in support of it*.

In order to understand this, to render it consistent with the views entertained of other diseases, it will be necessary to take a variety of circumstances into consideration; and unless this be done, I do not apprehend the great diversity of opinions and practice which exists at present can be reconciled, and the disease be made appear to be treated rationally and not empirically. When I hear, or am asked the question, How do you treat erisypelas? I consider the inquirer much on a par with him who asks me how I operate for cataract, neither complaint having any specific mode of treatment, but a general one, dependent on the state of the parts affected, the constitution and age of the patient, not to exclude peculiar predisposition or diathesis, or the presence of any prevailing or epidemic disease.

I am disposed to believe, that a good deal of error has arisen from considering erysipelatous inflammation as directly opposed to the phlegmonous, and that the term unhealthy, which has been applied to it, has led to the supposition of an

* Those who are desirous of consulting or learning the opinions of the more ancient authors, will do well to read Dr. Weatherhead's work on the Diagnosis between Erysipelas and Phlegmon, and Dr. Wilson Philip's Treatise on Fevers. Plouquet will supply the names of the remainder.

unsound and weak state of the constitution, in all instances, instead of its being present only in the greater number; and that some peculiarity of constitution, quite independent of its powers, may determine the nature of it, after a disposition for inflammation has been formed. That derangement of the primæ viæ can do this, Dessault, in his Surgical Journal, has amply proved, and no one is disposed to dispute it; that particular idiosyncracy can induce it, is, if possible, better substantiated; and that many hidden or obscure causes are equally capable of producing this peculiar inflammation, is I think fully established in the minds of most practitioners. According to this opinion, erysipelatous inflammation may occur in persons of the soundest and most healthy constitutions, without general or local defects, the particular kind of inflammation as to local characters being determined by some peculiarity of habit, general or acquired; whilst the constitutional symptoms are in like manner determined by the peculiar state of the constitution. The erysipelatous inflammation, in a case of this kind, ought not to be opposed to the phlegmonous under the denomination of unhealthy, for it is equally as healthy, in this instance, as any spontaneous phlegmonous inflammation, and the treatment should be similar, with reference to the great outline of the practice, due attention being paid to the nature of the peculiarity giving rise to the complaint. Every deviation from a healthy state of the system causes a shade of difference in the constitutional symptoms and treatment of erysipelas, in the same manner as the state of constitution, in cases of common febrile excitement, exerts its influence on the symptoms causing those varieties of difference which may be observed from synocha to typhus gravior. Erysipelas is then, in my opinion, to be treated according to the same principles as fever, according to the symptoms as dependent on the state of the constitution, and not with reference only to the name and local characters of the disease. Erysipelas, like all spontaneous inflammation, is in most instances much more of a constitutional than a local disease; it is frequently so in cases de-

pendent on external violence, and the local treatment is often as changeable as the general, whilst it ought always to be regulated by it: hence the great discrepancy of opinion as to local applications; some persons using cold, others preferring hot, and a third party denying both, and abstaining altogether from any applications. I cannot say that I have reason to coincide with either party, although I agree with the whole. The only difference is as to the peculiar case, and period for resorting to them. Whenever the constitution has been good, and the fever inflammatory, I have almost always used cold applications with advantage; of these I have found the liq. amnion. acetatis, in the proportion of one part to three or four of water, or with a small quantity of spirit, very useful; and when I have ordered a poultice and stimulant ointments to the wounds, the lotion has been freely applied to the surrounding parts. The decoctum cydonii is also a good remedy, especially in the erysipelatous inflammations of children, cooling and preventing, by its mucilaginous nature, the chafing of parts, as well as irritation. Vinegar and water has also been found useful, and more rarely the liquor plumbi subacet. dilutus. But when the constitution of the patient has been bad, or the fever partaking of the nature of typhus, I have found warm fomentations of poppy-heads, &c. with a small quantity of spirit, the best and the most comfortable application. Flour has been much recommended, as well as other absorbent powders, upon the principle of their absorbing any irritating secretion which may take place: I cannot say I have seen any benefit derived from it, except in the later stages of the complaint, when on the decline, and in the erythematous affections of old people, in which it seems to be of considerable service. In cases of erysipelas supervening on injuries of the head, I have generally followed the method first recommended, after an emetic had operated, and with due constitutional treatment. In the extremities, warm fomentations and poultices (the stale beer or fermenting from preference) have been most frequently found serviceable.

Erysipelatous inflammation is said to be common in all cases of lacerated wounds, and, therefore, of frequent occurrence in gun-shot wounds; but this is not the fact, for gun-shot wounds are, for the most part, inflicted on persons of good constitutions, and the inflammation, although often in excess, is generally healthy; and if a computation be made, it will not be found that the erysipelas is more prevalent in a given number of gun-shot wounds than in the same number of any other kind of injuries.

The erysipelas phlegmonodes, as it is termed, or that state in which the inflammation extends to the cellular membrane and forms an abscess, with little adhesive inflammation around it, so that the fluid secreted is not contained in a proper sac, but rather diffused through the part, giving to the finger the sensation of a partially circumscribed swelling, is by no means an uncommon complaint; and if the presence of matter regulates or decides the name of a disease, it may be said to be of very frequent occurrence, to be present in almost every case that does not terminate in mortification, and in which the inflammation extends deeper than the skin. The disease, as its name implies, partakes of the nature of phlegmon and erysipelas, inclining sometimes to the one, sometimes to the other, according as it is influenced by the state of the constitution and the strength of parts. The manner of terminating seems also to be regulated by the same influence. If the inflammatory action be high, and the constitution good, matter will be formed, and the cellular substance in which this occurs will slough; the same thing takes place if the power of the parts be deficient, and the accompanying fever be of a typhoid type; whilst, if the inflammatory action be moderate, and the strength of the parts equal to the action, whether they be of an inflammatory tendency or otherwise, the cellular substance in which matter is formed will not slough; but a serous discharge will take the place of pus for a few days, and the part in which the matter was retained will gradually re-

cover itself without further trouble and inconvenience, although the matter by no means approached the surface when the opening was made for its evacuation. A gentleman came under my care some time ago in consequence of two open buboes. He was naturally of a good habit of body, but had been trifling with himself in the country, and three days after he arrived in town, erysipelatous inflammation took place, and extended from the sores, down the thighs, over the lower part of the abdomen, and behind the trochanters. The febrile symptoms were those of synochus, and the disease apparently dependent on derangement of the primæ viæ. It was treated by purgatives, diaphoretics, and latterly cordials and opiates; matter formed, however, in considerable quantity, and was evacuated in the form of good pus, in three different places, *viz.* over each trochanter and in the middle of the left thigh. The openings were made as soon as any fluctuation could be discovered, and the lancet was pushed in to near the depth of an inch. After the second day the discharge became serous, the swelling of the part gradually diminished, and the openings closed up in a few days without further trouble. This case is related as illustrative of the state to which it applies, and in contrast to the following:—A poor woman, about the middle age of life, applied for advice in consequence of an erysipelatous inflammation of the whole lower extremity of the right side, of several days' continuance. The limb was greatly swelled, the inflammation was of a dark red colour, and gangrene was evidently to be feared; the febrile symptoms were also of a typhoid type. Warm spirituous fomentations were ordered to be kept to the parts, and to be frequently changed. Bark in substance, with the tincture and extract, and twenty drops of the spiritus ætheris sulph. comp. were administered every two hours, and a moderate quantity of wine. Under this treatment, matter formed first near the ankle, and in succession of formations for several days as high as the groin, large sloughs

coming away from each opening, requiring great attention, in the after-treatment, to the steady application of compression. In this case, which took a considerable time to effect a cure, the matter certainly first formed in the cellular membrane above the fascia, although that soon became implicated, and on the sloughs separating the muscles were laid bare. The last formations gave less trouble, in consequence of being opened as soon as the fluctuation of matter could be distinguished in the slightest degree, and the partially circumscribed swelling indicated the seat of the mischief.

In many cases the inflammation and subsequent suppuration is in no degree circumscribed, the cellular membrane sloughs in the whole circumference of the limb, the skin being undermined loses its vitality, and the consequences are often very distressing, and not unfrequently fatal, when the treatment is undecided. Mr. C. Hutchinson, in his Practical Observations in Surgery, has the merit of recommending a new mode of practice by incision into the inflamed part at an early period, which in most instances arrests the progress of the disease. His observations were not, however, at first received with that attention they deserved, more perhaps from the term erysipelas phlegmonodes, which he retained as the name of the disease, than from any other cause. Since that period this complaint has been more generally called diffused cellular inflammation, or erysipelatous inflammation of the sub-cutaneous cellular membrane, which is sufficiently characteristic of the seat and of the nature of the disease. If the simple term erysipelas be confined to an affection of the skin, no difficulty can occur in distinguishing these complaints, and error will be avoided in regard to the practice which is essentially necessary to be pursued.

This species of inflammation is usually the consequence of injuries; the skin assumes the erysipelatous tint, although it is in general something more of a brighter colour. The part swells more rapidly, does not admit of the impression of the finger being made with the same facility as in either common

erysipelas, or in the œdematous inflammation, and does not retain the mark in the same manner. There is clearly a thickening of the parts beneath the skin, which is also evidently on the stretch, is very tense, and therefore glistening. The pain is considerable; it is not, however, either, or the whole of these symptoms which attract particular attention, it is the rapid depression and derangement of the nervous system. The altered and subdued appearance of the patient from the previous day, his hurried manner, the quickness and irritable state of the pulse, the foulness of the tongue, heat of skin, and towards night a state of wandering or delirium, indicating the extent of irritation. If relief be not obtained, the swelling extends along the limb, the skin becomes of a darker colour, the erysipelas affecting it passes beyond, and is the precursor of the inflammation of the sub-cutaneous tissue; the distinction between them is well marked, and cannot be mistaken. The firmness of the part first affected has by this time yielded in some degree; its resistance or elastic feel is less evident, and it has obtained a springy fluctuating feel to the touch, which is peculiar, and which it has acquired before any matter has formed. On making an incision into the part at this period, the cellular tissue will be found to have changed its characteristic for a gelatinous appearance of a light leaden colour, which it obtains from the deposition of fluid into its cells, nearly in the act of being converted into pus. The septa composing the cells have not at this period lost their life, and the fluid does not at first exude, as it will be found to do a few hours later, when the matter deposited has become purulent. When this change has taken place, the patient is obviously in the greatest danger, and if the cause of irritation be not removed or alleviated, he will in many instances die under the most marked symptoms of irritative fever of a typhoid type. When the powers of the constitution are equal to sustain and resist this state of disease, relief is obtained by the sloughing of the skin, and the discharge of the matter beneath. The skin is however exceedingly tough, and

before it yields and dies, the fascia beneath the cellular membrane is often destroyed, and the muscles are implicated and exposed. Mr. C. Hutchinson thinks "pus is seldom formed in the substance of the adipose part of the tela cellulosa exterior to the aponeurotic expansion, that is, between this membrane and the skin; its most common position is beneath these parts, and in immediate contact with the muscles." This opinion does not accord however with my observation; the sloughing of the fascia, and the formation of matter beneath being most frequently caused by the continuance of the disease, and rarely occurring when the proper method of treatment has been adopted. Mr. Hutchinson recommends several small incisions to be made, about an inch and a half in length, and from two to four inches apart, varied in number from four to eighteen, according to the extent of surface the disease is found to occupy. I have found one or more longer incisions answer equally well, and they appear in many instances to be preferable, giving more decided relief, as one incision can sometimes be made so as to be very little remarkable, whilst several smaller ones occasion more deformity. On making an incision at an early period, the leaden-coloured and slightly gelatinous appearance of the cellular membrane will be readily perceived, and the state of tension of the skin will be immediately estimated by the retraction of the edges of the wound, one of four inches in length separating two in width. Sometimes a considerable quantity of blood will flow from the divided surface, but this will in general be greater if the incision be carried through the fascia, which is seldom necessary at an early period of the disease. If the operation has been delayed until the springy fluctuating feel, communicated by this gelatinous state of the cellular membrane, be changed into the more marked feeling which is communicated to the foot when stepping on a bog or quagmire, the cellular membrane will have been destroyed, the skin will have been undermined, a part of it must be lost, in spite of the operation, which will only be in time to allay the

constitutional symptoms, and thereby perhaps save the patient. I attribute these violent constitutional symptoms, not to the formation of matter, or the sloughing of the cellular membrane, but to the stretching and over-excitement of the skin when in a state of inflammation, caused by the swelling of the parts beneath; whence the relief obtained from the incisions. This opinion seems to be confirmed by the fact, that the constitutional symptoms subside, and the patient is placed in safety, although the incisions should not have been made until after the whole of the cellular membrane had passed into a sloughing state, and which process must be afterwards completed, and the parts separated, before the cure can be accomplished. The following case is so striking an instance of the efficacy of long incisions, and of their capability to remove the greatest constitutional irritation, that I do not consider it necessary to adduce more.

Thomas Key, aged 40, a hard drinker, admitted into the Westminster Hospital, as an accident, on October 21, 1823, at night, and under my care, in consequence of falling and striking his left arm against a stool four days previously, which had given rise to erysipelatous inflammation. He was smartly purged with calomel and jalap, on his admission, which was followed up the next day by small doses of the antimonium tartarizatum and sulphate of magnesia, so as to cause both vomiting and purging. In the evening he lost twenty-five ounces of blood from the temporal artery. The arm was very much swelled, the skin of an erysipelatous redness, very tense, elastic, springy, and yielding a sensation of fluctuation, the inflammation being evidently deep seated; pulse one hundred and twenty, strong, tongue dry and furred, great thirst, skin hot, is very restless, unruly, and wandering. After the bleeding he became quiet, a profuse perspiration broke out over the whole body; he appeared relieved and comparatively tranquil. Fomentation and poultices were applied every three hours to the arm.

On the 30th, his state not being improved, a consultation

was held to determine on the propriety of making incisions into the inflamed part; but this was considered improper by the parties consulted, and saline medicines with small doses of tinct. opii were substituted.

October 31. *Pulse one hundred and thirty,* he is weaker and more irritable, was delirious all night, and in a state of great restlessness, countenance sunk, skin dry and hot, tongue furred, and altogether in a state of extreme danger. The arm greatly swelled, of a darker colour, and giving to the touch a strong fluctuating boggy feel. I made two incisions forthwith into the fore arm; one on the back part eight inches in length, the other five inches long on the under edge in the line of the ulna down to the fascia, which was in part divided, and one vessel bled freely. There was not any matter beneath it, but a considerable quantity of serum and matter of a gelatinous appearance was discharged, mixed with venous blood, but no pus. The incisions did not give much pain.

November 1. *Pulse ninety* and steady; tongue furred, but rather moist; heat of skin moderate; slept occasionally during the night, and was much quieter; says himself he had a good night. The arm is less swelled; the cellular membrane is evidently sloughing, and this state extends beyond the extremities of the incision on the back of the arm, which was therefore augmented to the extent of eleven inches. Ordered to continue the saline mixture, four grains of calomel, and four of the extract of colocynth, and the infus. of senna and salts to be given afterwards, and repeated until a due effect is produced.

From this time he gradually recovered, the incisions were made, however, too late to prevent the loss of a considerable quantity of cellular membrane and skin.

When a deep-seated erysipelatous inflammation takes place below the fascia of a limb, the whole extremity swells, it becomes firm, heavy, of a dull whitish colour; and is scarcely affected by the erysipelatous blush; is painful, and rapidly

destroys the powers of life; the patient sinks unconscious of his danger, when he fancies himself relieved. The appearance of the part on dissection very much resembles that noticed page 97. It is a fatal termination by no means uncommon in persons of a bad habit, afflicted with erysipelatous and gangrenous inflammation or sloughing abscess in the neighbourhood of the rectum.

In the 48th number of the London Medical Repository, in a paper on "the Use of the Nitro-muriatic Acid Bath in several Diseases," I have related the case of a soldier, who was cured of several scrofulous ulcers by the use of the bath, and was shortly afterwards attacked by erysipelas of the head, extending over the whole body in a very alarming manner. This man's life was only saved by very large and repeated bleedings and warm fomentations; yet there was no reason to believe, from his previous history, that any inflammatory complaint, and especially erysipelas, would have required such very decided treatment.

I am at this moment attending three different cases, in one of which I have bled largely, in the other given bark and acids, in the third, camphor, diaphoretics, the carbonate of ammonia, and even brandy. It would be useless then to multiply examples in explanation of a subject, which no one can mistake, who is not so obstinately wedded to one opinion as to be determined not to change it. In all cases of gun-shot wounds, in which erysipelas supervenes, the treatment is to be regulated by the symptoms; and I believe the same principles ought to be applied to it in every circumstance or situation of life in which it may be met with. It is in many instances contagious.

There is an inflammation which I have seen several times occur in gun-shot wounds, which I do not perfectly understand, and which, as it is attended by peculiar and fatal circumstances, deserves particular attention. It is not common, seldom more than one or two cases occur in an hospital of a thousand men, and they generally take place after the first ten days.

My attention was first drawn to it after the battle of Al-

buhera, in consequence of losing three men very suddenly, whose death I did not expect, having seen them in the evening; and in all the three cases, on finding their places vacant in the morning, was informed on inquiry, that they had died during the night, and had been carried away. The death of the first did not attract my attention; that of the second left an impression which made me attend more particularly to the third, and to consider the affection as something peculiar. Two cases occurred after the battle of Salamanca, and one at Toulouse. I did not see a case among the wounded at the sieges of Ciudad Rodrigo, Badajos, or Burgos; the wounded at the battles of the Pyrenees only came under my direction at a period later than I have known it occur; neither did I see one at Brussels or at Antwerp after the battle of Waterloo. It is very possible some may have occurred, which escaped my observation.

This inflammation makes its appearance after the first ten days in every case, and in all that I have seen the injury was in the upper extremity. The wound, from being only a simple one without fracture, begins to swell, and to become painful, and the swelling increases. The redness, which is of a pale colour, more resembles the phlegmonous than the erysipelatous inflammation, whilst the skin has a shining, glossy appearance, and the tumefied parts retain, in slight degree, the impression of the finger, although the accomplishment of it gives great pain, and to a certain extent is resisted by the firmness of the parts below. The pain is not greater than in other cases of inflammation, and is rather burning than throbbing. The constitution sympathizes at first only in a moderate degree. The swelling and shining appearance continue to extend up to the axilla. The patient can sit up and wash his own arm (in two instances they walked about), and neither his countenance nor pulse indicates the near approach of dissolution, which in five or six cases took place a few hours after the last visit, when the appearances were such as I have described. In the five fatal cases, I could only learn that they got worse during the night, that is, the pain in-

creased, difficulty of breathing came on, and death. In all, this took place the day after the swelling had reached the axilla; and in the fifth case, the result appeared to me so certain at the same period of time, that I desired the orderly to take care, that if the man died during the night he should not be removed. This direction seemed to surprise the orderly, who had no suspicion that the man would die; but his first salutation at half past five in the morning, when I came into the hospital, was, "Sure, Sir, the man is dead." I relate the case in this manner to draw the attention more strongly to the impression it had made on my mind, that the complaint may not be overlooked on future opportunities offering themselves, and that it may not too hastily be considered as a common case of erysipelatous or œdematous inflammation. The three first cases were not examined after death. In the fourth I could discover nothing particular beyond inflammation of the veins, especially those leading to the axilla, the axillary vein being also inflamed, to which I attributed the man's death, without considering it very peculiar, being of frequent occurrence in fatal cases after amputation. In the fifth, the man died of effusion into the chest on the same side as the injury of the arm, the whole of which was much enlarged and had been highly inflamed, but the great veins were not affected as in the former instance.

The sixth case occurred after the battle of Toulouse, in the Caserne de Calvete hospital, under the direction of Staff-surgeon Boutflower, and in the immediate charge of Mr. Franklyn, now surgeon of the 37th regiment, to whom I pointed it out at its commencement as of very dangerous tendency, and it was from that moment an object of particular attention. The man was bled, purged, vomited, and diaphoretic remedies were administered, composed of calomel, antimony, and principally opium. Poultices were applied to the wound, and cold applications to the remainder of the limb. The arm swelled nearly up to the axilla, and I fully expected it would have taken the same course as the others, but it did not do so; the

inflammation gradually subsided, the arm diminished, and reassumed its usual appearance; the exact time I cannot mention, having lost the particulars of the case. During this process the man's health declined, he suffered an attack of fever, became afterwards jaundiced, and died under symptoms of diseased liver. There was nothing wrong at his death about the arm which had been inflamed.

It is from this termination that I have been induced to give the caution not to mistake the disease for a common case of unhealthy or diffused cellular inflammation; and even admitting that it should be hereafter proved to be so, there will still be something very peculiar in it, and deserving investigation.

I am disposed to hazard a conjecture, that it was effusion in the chest which carried off the first three patients; that the inflammation of the veins of the arm in the fourth was an accidental occurrence, although of this I am by no means positive. The treatment to be adopted, should be that which was made use of in the last case, and which proved successful in removing the inflammation, although the patient subsequently died from fever and visceral disease.

The last result of inflammation, that I shall notice, is mortification; a term which has been applied to such very different states, that it is necessary to consider it as applicable only in a general manner to a part deprived of life, in order that the name of the complaint may have no influence on its treatment. The death of a part of the body is, then, in modern surgery, denominated sphacelus, or mortification; and the term gangrene, which has been sometimes considered as synonymous, is restricted to the states immediately preceding it, in which some marks of vitality continue; but the word gangrene is not sufficiently expressive of the different peculiarities of each, and a further subdivision has been adopted into humid, dry, and traumatic. Humid gangrene*, when the death of the part has been preceded by a great deposition of

* Quesnai's Traité de la Gangrène, Paris, 1749.

fluids in it, and followed by putrefaction and general decomposition. Dry gangrene, when the death of the part has been preceded by little or no deposition of fluids in it, and followed by a drying, shrivelling, and hardening of the part, nearly in its natural form and shape, with few signs of putrefaction. Traumatic gangrene †, when it is produced by, or is the effect of external injury, and partaking generally of the nature of the first species, although admitting of some difference in its treatment. Surgeons have also sometimes bestowed the names of chronic and idiopathic gangrene, on certain states depending on internal causes, or which have occupied a considerable time without any great development of disease.

These terms, however comprehensive they seem to be, are not, I apprehend, sufficiently explicit; they indicate only the immediate state of the part, without alluding to the cause; or, if they do convey some idea of the cause, it is more likely to be a false than a correct impression. Gangrene being a disease from which we can reasonably expect nothing but the death of the part, the actual state in which it may be when such occurrence takes place is of little consequence, except as far as regards its connection with healthy parts, and the state of the constitution. The Baron Larrey, fully aware that the terms humid and dry gangrene did not sufficiently indicate the state of either, added to them the traumatic, with the view of designating a species in which the state of the constitution, and of the neighbouring parts, should in general be supposed to be sound, although the gangrenous part might partake, in appearance, of the nature of the other species, and in which a different mode of treatment might be adopted. I have here, then, given to the Baron's species the most extended sense it is capable of receiving; yet, it appears to me to be still objectionable, because neither the state of constitution nor of parts, nor the surgical treatment, are at all times alike, nay

* By the Baron Larrey, Mémoires de Chirurgie Militaire, tome iii, page 141.

even frequently differ most essentially in a very short space of time.

To convey to the mind of the surgeon a strong impression of the nature of the disease he has to contend with, as well as of the proper treatment of it, I have been in the habit, in my lectures, of making an additional distinction of constitutional and local gangrene, including the humid and the dry under either, as it might happen that the constitution was or was not materially affected; preventing, in consequence of this distinction, the mind of the surgeon wandering from the consideration of the main facts before him; and founding on it a practice essentially different, in many instances, from that which is usually received, whilst it elucidates or removes any discrepancy of opinion, which may have existed on some points of material importance.

By the terms constitutional humid and dry gangrene, I do not alone mean gangrene which has originated, as it may be termed, idiopathically; but in which the constitution or system at large is, or has become affected either primarily or secondarily. By local humid and dry gangrene, I understand a state of disease of a particular part, by which the constitution or system at large has not been implicated, or only sympathizes in a degree which is not felt to be generally detrimental to its powers of originating and maintaining actions, which may be subsequently required for the safety of the whole.

Mortification, or the actual death of a part, is admitted by all authors to occur from a variety of causes, and more attention has been paid to discriminating these, than to ascertaining their effects, or the manner in which they are produced. It appears to me, that, in the consideration of gangrene, the cause is comparatively of little importance, provided the effect produced on the system at large be attentively considered. The surgeon, in applying all or any of his curative means, adapts them to the state of the constitution and the parts in the vicinity of the disease or injury, rather than to the affected

spot itself. Gangrene may take place from excess of inflammation, arising spontaneously, or from external violence, constituting what has been termed the acute humid gangrene, in which case it is the last result of incurable inflammation of the part, every attempt at its suppression, made either generally or locally, having failed; every effort of nature being insufficient to prevent a termination, which she seems evidently to consider as most destructive. In making these efforts nature frequently exhausts herself; and if the powers of the constitution be bad, she yields at once to the further encroachment of this destructive foe to life, and the death of the whole rapidly follows the death of a part. Gangrenous inflammation always shows a weakness of part, whilst it may not demonstrate any of the constitution; in which case, the gangrene ceases with the destruction of the weakened part, and the separation between the dead and the living is duly effected. This will take place whether the inflammation be of a phlegmonous or of an erysipelatous nature, although it is more likely to occur in the former than in the latter, and more frequently in proportion to the smallness of the extent of the mortification, or the importance of the part affected. When mortification takes place from excess of inflammation, in a person of sound constitution and of parts, it is only after a very great effort of nature to prevent it, as demonstrated by every symptom; and we often find that the pulse keeps up some time after the gangrenous inflammation has commenced. The efforts of nature have here been too strong for the powers of the part weakened by disease; we accordingly endeavour to moderate them in the first instance by venesection, cathartics, and diaphoretics, and to allay irritation on the part by the appropriate remedies. When mortification has, however, taken place, we find that the constitution becomes immediately sensible of it, not by means of the absorbents taking up the gangrenous particles, as Baron Larrey supposes, but through the nervous and sanguiferous systems, which have been principally implicated in the disease, and have been entirely the instru-

ments by which nature has attempted to effect its suppression. The pulse sinks, the countenance becomes anxious, the shock which has been sustained is perceptible, and the surgeon now endeavonrs to revive the drooping efforts of nature, which has been vanquished in the struggle. If the powers of the constitution have been fundamentally good, nature is able once more to rally, and although the part is completely irrecoverable, still she is capable of surrounding it, as it were, with a line of circumvallation, preventing the further encroachments of the disease, until, by renovated efforts of a slower but surer nature, she is able to cast it off altogether. But if the powers of the constitution have been bad, it is precisely the reverse, nature seems to have completely exhausted her strength in the struggle, and to be totally unequal to further resistance. As water which is capable of being cooled below the freezing point without congealing, and remaining in this state for some time, on the slightest agitation, freezes almost instantaneously in every direction; in like manner does nature resist the encroachment of mortification, but with such loss of the principle of life, that when overcome, the deprivation of the remainder takes place almost as suddenly as the congelation of water cooled below the freezing point; the progress of the mortification along the limb is comparatively as rapid, the pulse immediately sinks, pain ceases, the skin becomes cold, perspirations break out, the countenance is inexpressibly anxious, and death soon closes the scene. In such a case, fully aware as a surgeon ought to be, from his general knowledge, of its true state, instead of endeavouring, as in the preceding one, to diminish what he considers the irregular or ill-adapted efforts of nature, he ought to sooth and support them, so that they may not be expended on the first and ineffectual struggle, but preserved as unbroken as possible for the succeeding attempt at restraining the disease within reasonable bounds, and of subsequently casting it off.

Amputation of a member affected by mortification, under such circumstances, is forbidden, and wisely so, by all modern

surgeons; the operation having been found in most cases useless, if not directly detrimental; the same action taking place on the stump, in consequence of the reduced or bad state of the powers of the constitution, which second attack has almost invariably been fatal, and the patient thereby deprived of the chance which might have existed of nature being equal at a subsequent period to throw off the mortified part. The operation of amputation is an injury that the powers of the constitution are incapable of bearing; they are now unequal to maintaining, and barely of originating the actions necessary for the recovery of the part. Inflammation scarcely commences before it ceases in the death of the part, the presence of it being shown not by its usual phenomena of pain, heat, redness, and swelling, but by a greater degree of white doughy tumefaction, of uneasiness, rather than pain, which is more general than local, accompanied by little or no increase of heat or redness; certain forerunners of death. If the operation should have been performed on a person of better constitution and powers, the stump may go on well for a day or two, and then actual gangrenous inflammation supervene, as in persons of deficient powers, which will be followed by death. The axiom in surgery is then a good one, "that whenever the constitution of the patient is implicated, whenever the powers of nature are considerably exhausted, the operation of amputation should not be resorted to until the line of separation is fairly established." Amputation in this state is performed only when a part of a limb is completely destroyed; it is done to shorten and relieve the operations of nature, and to render the remaining portion of it more serviceable, or useful to the patient. It is consonant to reason that this injury, which is intended to be a beneficial one in its result, should only be committed, when nature has so far recovered from the preceding struggle as to be able to set up and support the new actions required of her; and the appearance of the line of separation is a fair proof of her capability to do so.

In cases of what is termed chronic, idiopathic, or dry gangrene, the disease is admitted to be the effect of constitutional derangement, whether it be caused, as it may reasonably be supposed to be, by improper food, such as rye in a state of what is called cockspur, or by the French ergot de cocq, or by some less obvious cause producing that species which Quesnai* and Mr. Pott† have so ably described. For a compen-

* "There is nevertheless a dry gangrene, which commences with a kind of external and superficial inflammation, but without swelling. The gangrene which ensues is always accompanied in its progress by a similar inflammation, which precedes and announces its approach. It supervenes upon this inflammation so rapidly, that time is not given for the formation of matter, the appearance of which is the only mark of a cessation of the gangrene, and a proof that the arteries retain sufficient power to enable them to perform their proper functions.

"Dry gangrene is preceded and followed by considerable changes in the colour of the part. In general, the part which is about to suffer becomes red as if a little inflamed, but without swelling, tension, or any particular increase of heat; the skin and flesh often become even firm and slightly œdematous, at the spot where the redness resembles that of a slight erysipelatous affection. This brightness soon becomes tarnished, and quickly degenerates into a livid colour, and lastly to blackness. As this redness advances, the progress of the mortification is foreseen, and a tolerably certain prognosis of its state may be formed from the changes which are observed in the colour of the inflammation."

† Mr. Pott's account of dry gangrene attacking the toes is as follows: "It is very unlike to the mortification from inflammation, to that from external cold, from ligature or bandage, or to that which proceeds from any known or visible cause, and this as well in its attack as in its progress. In some few instances it makes its appearance with little or no pain; but in by much the majority of these cases the patients feel great uneasiness through the whole foot and joint of the ankle, particularly in the night, even before these parts show any mark of distemper, or before there is any other than a small discoloured spot on the end of one of the little toes.

"It generally makes it first appearance on the inside, or at the extremity, of one of the smaller toes, by a small black or bluish spot.

dious account of the first species, the work of Dr. Thomson on Inflammation may be consulted, the disease having been seen but once in England, and was then described by Dr. Woolaston in the Philosophical Transactions for 1762. Being universally admitted to be constitutional diseases, amputation has been forbidden, on the same principles and for the same reasons as in the preceding states of humid gangrene.

The descriptions given of humid and dry gangrene seemed for a long time to satisfy the minds of surgeons, and the practice resulting from them prevailed and obtained so generally, that it was considered, every kind of gangrene which could

From this spot the cuticle is always found to be detached, and the skin under it to be of a dark red colour.

"If the patient has lately cut his nails, or corns, it is most frequently, though very unjustly, set to the account of such operation.

"Its progress in different subjects, and under different circumstances, is different; in some it is slow and long in passing from toe to toe, and from thence to the foot and ankle; in others its progress is rapid, and horridly painful. It generally begins on the inside of each small toe, before it is visible either on its under or upper part; and when it makes its attack on the foot, the upper part first shows its distempered state by tumefaction, change of colour, and sometimes by vesication; but wherever it is, one of the first marks of it is a separation or detachment of the cuticle.

"Each sex is liable to it; but for one female in whom I have met with it, I think I may say that I have seen it in at least twenty males. I think also that I have much more often found it in the rich and voluptuous, than in the labouring poor; more often in great eaters than free drinkers. It frequently happens to persons advanced in life; but is by no means peculiar to old age. It is not, in general, preceded or accompanied by apparent distemperature either of the parts or of the habit. I do not know any particular kind of constitution which is more liable to it than another; but, as far as my observation goes, I think that I have most frequently observed it to attack those who have been subject to flying, uncertain pains in their feet, which they have called gouty; and but seldom in those who have been accustomed to have the gout regularly and fairly. It has by some been supposed to arise from an ossification of the vessels; but for this opinion I never could find any foundation but mere conjecture."

occur must fall within the limits of one or the other. The Baron Larrey, perceiving that both the theory and practice admitted of exceptions, added that species of gangrene resulting from wounds which he called traumatic; but as his ideas and mine do not quite coincide, I shall notice his opinions more at length. "When gangrene," he says, "arises from external mechanical causes, which affect directly the vitality of parts, it is constantly preceded by inflammatory swelling, erethismus, and a greater or less dilaceration of the capillary system of vessels. The injured parts become tumefied by the vital actions of those textures which as yet are not totally deprived of life; the epidermis is detached, and forms phlyctenæ, which are filled with a serous fluid, the cutis is softened, acquires a blackish hue, and putrefies: the cellular membrane and other textures are decomposed, from which decomposition a superabundance of fluids is derived, which have caused the name of humid gangrene to be given to this species. We find, however, in the midst of this putrefactive mass, and especially when the affection is not complete and the commotion has not been very violent, some muscles, arteries, and nerves, still in possession of a part of their living powers, and resisting to a certain extent the tendency to gangrene.

"Spontaneous gangrene generally shows itself in the most remote parts of the body, or in those in which the vital powers are weakest, such as the feet, the nose, the ears, and the fingers; whilst the traumatic gangrene may appear in any part that has been injured. In the first case it is a *deleterious substance,* which invades parts most distant from the centre of life; in the second, the injured parts have suffered only a relative disorganization. In either case the different textures of the part are struck with death; but as the vessels in dry gangrene had not undergone at first any alteration, they are less distended than in traumatic gangrene, and more especially if it be the effect of cold, or the sufferers have been enfeebled by previous disease. The part blackens, and instead of swelling, as in traumatic gangrene, it shrinks, dries, and sometimes

hardens, constituting dry gangrene, which only differs from the traumatic in there being no extravasation or congestion of fluids. The reason of this in dry gangrene is, that the vessels are uninjured, whilst in the traumatic they have been ruptured. Dry gangrene is more readily arrested, because the different textures of the part, being supplied with vessels and nerves having direct communication with the centre of life, are better able to resist the morbific infection. It forms a circumscribed inflammatory line, which separates the sound from the affected parts, and prevents the propagation of the gangrenous principle, in consequence of the closing of the mouth of the sanguiferous and absorbing vessels by adhesive inflammation. In this case no inconvenience results from waiting until the mortification is arrested before amputation be performed. It is not the same with traumatic gangrene, which spreads with great rapidity along the whole of a member, affects the trunk, and kills the sufferer with little delay. It may readily be conceived, that the parts immediately above the gangrenous spot retain sufficient power to render them capable at the same time of absorbing the gangrenous principle, and of participating in the same inflammation and erethismus which precede it. In this manner the progress of the disease, and the impossibility of arresting it, are explained. In addition to this local continuous inflammation, the disease is propagated by metastasis of this gangrenous principle, either by the cellular texture, or by one of the vascular systems, to the brain, which soon becomes affected, the intellectual faculties are impaired, the animal functions are weakened, great anxiety and delirium supervene; and if the contagion continue to be propagated, the patient is destroyed. On opening the bodies of persons who have died under these circumstances, the arteries of the brain and the heart have been found full of liquid black blood, highly carbonized.

"In dry or spontaneous gangrene, absorption is accomplished with more difficulty, the disease remains latent for a greater or a less time; and it is not uncommon to see a morti-

fied part thrown off by the efforts of nature alone, the general functions of the body being little altered."

At page 152 he says, "It is easy to conceive, from what has been said, that in traumatic gangrene it would be dangerous to wait until the line of separation be formed before we amputate, because putrefaction is communicated without obstacle, not only by contagion, but by absorption, or transudation from the part first *infected* to the rest of the limb. Whatever, then, authors may say to the contrary, amputation should be resorted to, as soon as the death of the part, and the consequent loss of the limb, is demonstrated. The supervention of gangrene on the stump is not to be feared as in spontaneous gangrene, in which the line of separation is not established, because traumatic gangrene is only propagated by absorption, and an affection of the different textures, which swell in consequence of the continuity of vessels along which the disease successively passes. In fact, amputation, done at the proper place, arrests its progress and prevents a fatal termination of the disease: it destroys at once the propagation of the gangrene by contagion, and, by cutting across the nerves and vessels, relieves them from any fluids which may be stagnated in them; their natural action is re-established, and the parts are soon restored to a healthy state. The efforts of nature are to be seconded by bark, wine, tonics, &c." The Baron Larrey supports his opinions by the relation and notices of several successful cases of amputation, in which the gangrene was spreading when the operation was performed. The theory on which they are founded appears to me to be exceedingly defective. He considers this humid or traumatic gangrene as a deleterious principle, which is capable of spreading by infection or contagion, and is consequently irresistible; whilst he supposes, on the contrary, that the gangrene which arises from cold*, when it reaches sound parts, becomes a stimulant, and induces the vessels to act in order to separate the dead from

* See his Memoir on Gangrene arising from Cold, tome iii, p. 60.

the living parts ; an hypothesis which is entirely imaginary, supported by no known principles, and invented apparently to account for a difference which he could not otherwise explain. In the first place, it has not been demonstrated that any contagious or deleterious principle exists in gangrene which occurs, as in some of his cases, in twenty-four hours, or two or three days, after an injury which has destroyed the life and sensibility of a part. Gangrene or mortification is, under such circumstances, in its most simple form, that of a sudden deprivation of the life of a part, which *cannot* possess any deleterious qualities until putrefaction takes place, which can only occur at the end of two or three days from the receipt of the injury, and then under more favourable circumstances than from any other cause. If, then, mortification arising in this manner, as the result of sudden death, is capable of generating a deleterious principle, it is not possible to conceive that any other kind can be free from it, or that it can generate several, or even two kinds of principles ; one that shall be destructive to the powers of life, the other merely stimulant, and inducing them to healthy action. The reasons on which the Baron Larrey founds his practice, in either kind of gangrene, I consider to be erroneous ; and I do not indeed think he has given to the subject all the development it is capable of receiving.

Traumatic gangrene may, in opposition to the opinion of the Baron Larrey, be of two kinds, humid and dry, or both species may obtain in a limb at the same time, but under particular circumstances.

A cannon-ball, striking a limb, destroys the life of the part, in a greater or less degree, according to the extent of the injury effected ; if the blow be received on the middle of the leg, the bone broken, the arteries divided, or rendered incapable of carrying on the circulation, mortification takes place in the foot, because it is deprived of its usual support ; it is possible, however, that this may not follow immediately, as it may not be entirely deprived of blood, which passes into it in small quantity from the parts above, connecting it with

the rest of the extremity. The parts immediately above those actually struck by the ball have received a very considerable shock, and their sensibility is much impaired; and, when any action takes place in them, they will sometimes be found unequal to sustain it; and as the action attempted to be set up is inflammation, the failure of support causes it to fall into gangrene. It is, however, a failure of support, not from want of power in the constitution, exhausted by a serious struggle, but from incapability of the parts to maintain it. The extent to which this debility of parts may extend is uncertain, and the limits to the mortification must be so likewise, if left entirely to nature: it is evidently a struggle on the part of the constitution to reanimate the drooping powers of the part, which are unable to bear the assistance attempted to be afforded them. Inflammation then precedes the mortification, the limb swells, and has every appearance above the wound, as the disease advances, of humid gangrene. It began as a local disease, the part being simply unable to live, and nature having received a shock, as I conceive, entirely through the nervous system, and not by the absorbents, endeavours by means of an additional supply of blood (as she invariably does in every case of injury) to recover the parts in jeopardy, to renovate their strength. If the parts are capable of bearing this, healthy inflammation is established and the mortification ceases. The disease is, from the moment inflammation is *established*, no longer local, the constitution is beginning to be implicated; and, if the struggle be continued, it becomes a case of mortification, dependent, according to my principles, on constitutional causes. Nature seems to suffer in the deprivation of the principle of life whenever she becomes sensible of the death of any part of the body, and in a greater proportion than would seem to be commensurate with the supply of that part in a state of health; she becomes weakened of course more by the death of a part than by its amputation; and upon a principle connected with life, which we cannot explain. When the inflammation commences, the great point

for observation is whether the power of the part can or cannot maintain and carry it on to the healthy, adhesive, and ulcerative stages. If nature can accomplish this, she ought not to be interfered with; but if it appear that the part is incapable of supporting the efforts of nature, or, what is worse, that she is incapable of making them; is she to be allowed to exhaust herself in a fruitless struggle, or is assistance to be given the instant the inability of the part is seen, and just as the powers of nature are displaying themselves? I have no hesitation in saying, that the disease is yet a local one, nature is only showing what she will do if properly seconded; and that, if her efforts are directed to sound parts, capable of sustaining them, she will be able to make a sufficient and successful struggle. Amputation, then, is to be performed in sound parts, to which the usual efforts of nature will be directed; and, if they be unbroken, or only impaired by the previous injury, the result will be fortunate: but the inflammation will not be sufficiently powerful to be able to stop at the adhesive stage, union will not take place to any extent in the stump; suppuration should therefore be encouraged as a natural consequence, and no more adhesive straps should be applied than may be sufficient to keep the parts together, so as to prevent retraction. Warm fomentations and poultices should be preferred to cold applications, and the ligatures should all be cut short.

It sometimes happens, that a cannon-ball strikes a limb, and, without apparently doing much injury to the skin, so completely destroys the internal textures, and deprives them of life, that gangrene takes place without almost an effort on the part of nature to prevent it. This kind of injury was formerly attributed to the wind of a ball; but the opinion was abandoned from a total want of any positive evidence in support of it, whilst much negative evidence can be brought against it. It was next supposed, by Mr. Ellis, to depend upon electricity generated by the passage of balls through the air; but this hypothesis is in precisely the same circumstances

as the other; indeed every thing would tend to prove that both are without the slightest foundation. The Baron Larrey has hazarded a conjecture which seems nearer the truth; for, after having seen the end of the nose, an ear, the hat, the sword, the great coat, and all parts of the body grazed, and even carried away by cannon-balls, without these effects following, it is impossible to conclude that either the wind of the ball, or the electricity collected or generated by it, is capable of producing them, more especially, as the shot causing such mischief has always been observed to be a spent ball, or deprived of the greatest part of the force with which it was impelled. He says, "a cannon-ball is propelled at first with a rectilinear movement; and if, during this part of its course, it strikes against any part of the human body, it carries it away; but the ball, after having traversed a certain distance, undergoes some change of motion in consèquence of the resistance of the atmosphere and the attraction of the earth, and turns on its own axis, in addition to the direct impulse received from the explosion of the powder. If it should strike any part of the body when the velocity with which the ball is passing is greatly diminished, it does not carry it away, as in the preceding case, but, in consequence of its curvilinear or rolling motion, it turns round the part, in the same manner as a wheel passes over a limb, instead of forcing a passage through it. The soft elastic parts, such as the skin, and cellular membrane, yield, whilst the bones, muscles, tendons, arteries, &c. offering a greater degree of resistance, are either bruised or ruptured. If the ball should strike one of the cavities of the body, the viscera suffer in like manner."

The patient, after an accident of this kind, is brought to the surgeon, sensible of having received a severe blow on the part affected; which does not show much external sign of injury, the skin being often apparently unhurt, or only grazed, the motion of the part is lost, and it is insensible; the bone or bones may or may not be broken; but in either case, the sufferer, if the injury be in the leg, is incapable of putting

it to the ground. After a short time the limb changes colour in the same manner as when severely bruised, and the necessary changes rapidly go on to gangrene. The limb swells, but not to any extent, and more from extravasation between the muscles and the bones than from inflammation, which, although it is attempted to be set up, never attains to any height. The mortification which ensues tends to a state between the humid and the dry, and rather more to the latter than the former. These cases are not of frequent occurrence, and are not commonly observed until after the blackness of the part, and its want of sensibility and motion, attract attention; for the patient is generally stupefied at first from the blow, and the part or parts about the injury feel benumbed. I made these cases an object of particular research after the battle of Waterloo, but I could find only one among the British wounded. The man stated that he had received a blow on the back part of the leg, he believed from a cannot-shot, which brought him to the ground, and stunned him considerably. On endeavouring to move, he found himself incapable of stirring, and the sensibility and power of motion in the limb were lost. The leg gradually changed to a black colour, in which state he was carried into Brussels. When I saw it, the limb was black, apparently mortified, and cold to the touch; the skin was not abraded; the leg was not so much swelled as in cases of humid gangrene; the mortification had extended nearly as high as the knee, there was not any appearance of a line of separation, and the appearances of inflammation were so slight, that amputation was performed at my request by Mr. Campbell, now Deputy Inspector of Hospitals, immediately above the knee. On dissecting the limb, I found that a considerable extravasation of bloody fluid had taken place below the calf of the leg, and in the cavity thus formed some ineffectual attempts at suppuration had been made. The periosteum was separated from the tibia and fibula; the popliteal artery was, on examination, found closed in the lower part of the ham by coagulable lymph, proceeding from a rupture of the internal coat of

the vessel. Two inches below this, the posterior tibial and fibular arteries were completely torn across, and gave rise, in all probability, to the extravasation. From this dissection it would appear (and I have observed the same thing take place in others), that the internal parts were not entirely deprived of life by the blow, or the popliteal artery would not have been closed by coagulable lymph, the blood extravasated changed into a sanious fluid*, or the attempts at the formation of matter commenced; but that they died shortly afterwards, without much effort on the part of nature to prevent it. The death of the part being soon accomplished, and almost without a struggle, the constitution became less sensibly affected by it; and, for the first few days, it may fairly be considered as a case of local gangrene. When the operation was performed, the constitution was certainly affected, but only in a slight degree, and the operation therefore succeeded, although the man died subsequently from dysentery. The proper surgical practice in such cases is to amputate as soon as the extent of the injury can be ascertained, in order that a joint may not be lost. It is hardly necessary to give a caution not to mistake a simple bruise or ecchymosis for mortification. To prevent such an error leading to amputation, the Baron Larrey has directed an incision to be previously made into the part, and to this there can be no objection.

In order to meet the whole of this question fairly, it is necessary to notice gangrene taking place from wounds by musket-balls, which cannot, by the shock which they cause, or the force with which they are impelled, deprive the part of life. When gangrene occurs, then, from a wound made by a musket-ball, it must be in consequence of having divided the great vessels and nerves, or from inflammation running on to excess in persons of unhealthy habits. The latter state alone will at present occupy our attention, inasmuch as I do not consider it as a local disease, but dependent on constitutional causes, and therefore not coming within the limits of the

* Of this there may be some doubt.

rule of practice for traumatic gangrene. I cannot understand how gangrene can follow a wound from a musket-ball but from excess of inflammation, unless the great vessels or nerves supplying the limb have been divided by it, and therefore I am not competent to argue the point. The Baron Larrey states the fact in his Memoir as occurring in two cases; I cannot, however, from attentive consideration of these cases, suppose them to be simple wounds, and I am more especially led to this conclusion from the circumstance of the mortification being rapidly induced, and beginning in the extremities of, rather than at the injured part of the arm; and although the operation was in both cases successful, I am disposed to attribute it to the mortification being more immediately local, according to my opinion, than the Baron suspected. If the mortification had been the result of high inflammation, the parts far above the seat of injury would have been affected by it. Amputation, as a general rule, in cases of traumatic gangrene, placed in opposition to that of never amputating in cases of gun-shot wounds, until a line of separation between the dead and living parts is distinctly marked, I think the best. It admits, however, of exceptions, and principally where the gangrene does not come on quickly, from want of power in the parts arising from deficient nourishment; but, where the inflammatory action has been high, has included the neighbouring parts to some distance, has continued some days, and gangrene appears to have occurred in consequence of this excess of action; or when it takes place in a constitution debilitated and injured by hard drinking, or long residence in a tropical climate. In these cases, where there is much constitutional affection, amputation would not be so advantageous as awaiting the line of separation.

The operation must be performed on parts partaking of the inflammatory disposition; it is done whilst the constitution is in a state of great irritability, and the operation would act as an additional stimulus to increase it. Where gangrene,

however, is rapidly extending towards the trunk of the body, without any hope of its cessation, the operation is to be tried; for it has certainly succeeded where death would, in a few hours, have ensued. Under these circumstances, the nature of the operation, and the reason for doing it, should be clearly understood by the friends of the patient before it is performed. I may add, that where the constitution was bad, I have always failed either in amputating on the approach of gangrene, in the hope of avoiding it, or when it had apparently ceased.

In hot climates, if a cannon or grape shot were to destroy so effectually as to cause the death of the parts injured to a considerable depth, and gangrene appeared to spread with little preceding inflammation on the third or fourth day, and especially if this injury were near the trunk of the body, amputation would be advisable; for I do believe it would rapidly extend, and the line of separation would never be formed, as I have seen in several cases of this kind, which terminated fatally in forty-eight hours after gangrene had commenced.

In the first edition of my work on Injuries of the Extremities, I described another species of gangrene, which had been but little attended to, and which is more purely local than any which have yet been noticed.

A soldier may receive a flesh wound from a musket-ball in the middle of the thigh, which passes through the limb apparently without injuring the main artery; or, it may pass close behind the femur, where the artery turns to the back part of the bone; or it may go through the middle of the bone, from behind forwards between the condyles of the femur into the knee-joint, and the patient shall walk to the surgeon with little assistance, be superficially dressed, and, in many cases, considered slightly wounded; yet the femoral artery and vein in the whole of these cases, and, indeed, in many others, may be wounded, or cut across, and

the local inflammation be so slight, as to obtain little attention. On the third or fourth day, however, the patient shows his toes discoloured, and complains of pain and coldness in the limb below the wound, the constitution begins to sympathize with the injury, and the surgeon probably thinks the case extraordinary. Perhaps he suspects the real nature of the case, but is surprised that a wound of the femoral or popliteal artery, with so little attendant injury, should cause mortification. The more he considers, the more clearly does he recollect, that the anastomosing branches are declared to be sufficient to nourish the limb; and their not doing so here, he thinks still more extraordinary. He is anxious to do something, but mortification, or at least gangrene, having commenced, he must, according to general rule, await the formation of the line of separation. The temperature of the leg, a little above the gangrene, is good, perhaps higher than natural; he hopes the mortification will not extend further, and it probably does remain stationary for a little time; at last, the parts originally affected, the toes, become sphacelated, and gangrene quickly spreads up the leg as far as the wounded artery, by which time the patient dies. This accident occurs more frequently than is generally suspected, being placed to the account of gangrene from other causes, especially if there be a wound of any magnitude, and of course more attendant inflammation.

I believe two errors are committed here; one, in supposing that the anastomosing branches are sufficient to support the limb in the majority of cases, when the great blood-vessels are wounded by gun-shot: the other, of waiting for the line of separation, or rather the cessation of the gangrene; for if the wounded vessels be in the middle of the thigh, it will extend to the seat of the injury, and destroy the patient, before the action of separation can commence. To obviate this misfortune, amputation is to be performed where the artery, or artery and vein, have been divided, as soon as the

gangrene is perceive to extend beyond the toes; and the swelling and slight attendant inflammation, which is marked more by the tumefaction than the redness of the part, has passed up higher than the ankle.

The constitution at this period will have sympathized but little with the injury, and gangrene after amputation will not occur in the stump, as most frequently happens in sphacelus from other causes. I may here add, that the stump is to be tenderly treated, not bound firmly down by adhesive plaisters if it will not unite kindly; and such constitutional symptoms as arise are to be moderated as in other amputations.

I by no means intend to assert, that the anastomosing branches of arteries are not equal to carry on the circulation in the extremities in every instance, where the main artery has been wounded, for I know the contrary; indeed, in the upper extremity it will almost invariably be effected; but in the lower, where there has been no previous disease, and the femoral or popliteal artery be divided by a musket-ball, the anastomosing branches cannot always carry on the circulation, and sphacelus will affect the toes. I think I have seen it cease at a part of the ball of the great toe, in an unsuccessful case of femoral artery tied after a gun-shot wound; and I have seen it in other cases destroy the patient. If the vein accompanying the artery be injured, I believe mortification of the extremity to be inevitable; and in gun-shot wounds there is frequently more or less injury of the vein, as well as of the artery.

In cases of wounds from cannon or grape shot, the effects of the injury cannot be so well observed, from the practice of immediate amputation. In doubtful cases, or wounds from shells or grape-shot, where there is a hope of saving the limb, gangrene is more frequent; but then it is attributed to the effect of the general injury, rather than to the division of the vessels, and the defective state of the circulation. The nature of the gangrene to which I particularly allude, is always

pointed out by its commencing below the wound; for example, if with a wound near the elbow, the hand first becomes gangrenous, or even at the same time as the wound, with little inflammation in the vicinity, the trunk of the brachial, or the radial and ulnar arteries have been divided. If the foot and leg become gangrenous, where the wound has been in the leg by a grape-shot passing through the tibia, or with a wound of the ham or thigh, the principal artery or arteries have been wounded, and in all probability the great vein has been injured. A wound of the tibialis antica, or postica, singly, will not cause it, as either vessel is sufficient to support the limb, even if the fibular artery be also injured.

This mortification arises from no previous defect of constitution, in which the whole system must participate; it does not follow a long-continued or excessive action, which the vitality of the parts cannot sustain, and to the support of which contest the whole system has been, and is still contributing; but, from the sudden subtraction of the blood of a part, on which its life depends, and in consequence of which it dies, nearly in the same manner as the whole animal would do on the cessation of the function of the heart. The part is cold, insensible, of a deadly white colour, and with no surrounding inflammation; but the patient soon complains of numbness, afterwards attended with pain, the skin becomes streaked and discoloured, and the living parts in the immediate vicinity are slightly tumefied. The general state of the patient at this period is but little affected, the pulse hardly accelerated, little heat of skin, thirst, want of appetite, or derangement of the sensorial functions. There is not that appearance of the countenance which attends mortification of a part of the body from constitutional causes. This state continues for three, four, or more days; there is a struggle to support the limb; if the wound be in the middle of the thigh, the calf of the leg is as warm, probably warmer to the touch than the other, a little more swelling and redness bounds the gangrenous part, the patient becomes restless, the whole system is affected, there

is fever. In the course of a few hours, the limb swells to the calf, is very painful, tumid, yellowish, and streaked with bluish lines, the swelling visibly extends, it passes the knee, the patient expresses much anxiety, becomes delirious, and dies. During the first few days, where there is no very evident sympathy of the constitution, I consider amputation will be successful, if performed at the spot where the vessels are wounded; and I recommend it to be done as soon as the death of the toes and part of the foot indicates the defect of the circulation. If this stage should have passed by, and the gangrene has suddenly begun to extend, I would refer to the original wound; if it is above the knee, I would amputate instantly; for, although it may at this period be unsuccessful, the patient has a chance of living, which he will not have if he be neglected. If the gangrene should have already extended as far as the wound in the leg or ham, without much constitutional affection, it will probably stop there; and the line of separation will be formed, which should be awaited; but the patient will have little chance of escaping with life.

Having lost all the cases of gangrene succeeding to wounds of arteries, and other cases of greater injury, in which it supervened on the third or fourth day without much previous inflammation, I began to think it an error to wait for the line of separation, when there appeared but little prospect of its formation. In two cases after the battle of Salamanca, in which I had reason to think the gangrene was of this kind, I amputated with success; a third died after amputation, but not of gangrene affecting the stump; and the fourth and fifth, which I left for the appearance of the line of separation, on the cessation of the gangrene, very soon died. This practice, in cases of severe injury after gun-shot wounds, has succeeded in the hands of others, even in England.

There is a great peculiarity in this species of mortification, which is, that at the same period the two states of humid and

dry gangrene may be seen in the same individual, and part affected. On the first failure of the circulation, the toes, if in the lower extremity, shrink, become cold, insensible, and die, assuming a livid, and then a black colour. In this state they may continue for days, and be finally separated, or the mortification affects a part of the foot and then ceases. So far the mortification is purely local, and the limb above shows no sign of inflammation; but nature soon attempts to recover what she has lost, or relieve herself, and she effects it, or perishes in the attempt. If successful, a line of separation is established; if otherwise, the limb swells, humid gangrene takes place from weakness of part and debility of constitution, and spreads so rapidly as to be almost observed in its progress by an attentive eye. The hours of the patient's life are numbered, and nothing can save him but amputation, and that only when done the moment the spreading of the gangrene commences, for at a subsequent period it will be too late.

Mr. Samuel Cooper, in his First Lines of the Practice of Surgery, has noticed my observations on this kind of gangrene; but in the ensuing remarks on the subject he has not been able to divest himself of the impressions arising from ligatures made on arteries suffering from aneurism, and would induce his readers to suppose, in opposition to the opinions I have given, that a large artery may be tied, or divided, without fear of gangrene. He says, page 64, " On the whole, perhaps, we are not yet authorized to infer, that the mere interruption of the circulation through the main artery of a limb, and the simultaneous stoppage of the nervous influence, derived from one of the principal nerves of the member, would generally occasion mortification, if there were no other additional violence or injury done to the part." He then supports his argument by instancing cases in which aneurism had existed; but the state of an artery unexpectedly injured, is as different as possible from the state of an artery affected by aneurism; and the success of one operation is so far from

bearing upon the case of the other, and so far from being similar, as to be precisely the reverse; and I invariably establish it in my lectures as a demonstrated fact, that the theory of the cure of aneurism can in no way be applied to the treatment of wounded arteries, without the greatest error being committed. I am obliged then, in justice to myself, to reiterate my observation, and to confirm it by saying, that I have never seen a case in which the popliteal artery and nerve were divided, without mortification following as a necessary consequence. I do not believe a case of this kind ever did occur without it; and I am, I conceive, fully authorized to put my positive experience against any negative opinion, until cases, in which gangrene did not take place, are adduced in support of it. I have made exceptions in favour of the upper extremity; but Delpech states, that mortification has almost always taken place when the nerve accompanying the axillary artery has been included in the ligature*.

I beg to be understood as making these observations on that part of Mr. S. Cooper's work alone, which relates to wounded, and not diseased arteries; for, in regard to the latter, sounder or more truly surgical opinions are not any where to be met with, and, therefore, ought to be duly appreciated.

A mortification, very similar to this, occasionally takes place in the feet of persons suffering from typhus fever; but essentially different from the dry gangrene affecting the feet of old people and voluptuous livers, which Mr. Pott has described. During the winter of 1812-13, typhus fever, in a very concentrated form, made great havoc in that part of the army which was cantoned in the north of Portugal, where the troops were badly fed, clothed, and lodged, and especially among the recruits. In many of these cases, the feet were lost before it was known they were affected; and I have a foot, given to me by my colleague, Dr. Charles Forbes,

* Précis des Maladies reputées Chirurgicales, tome i, 98.

which is an excellent specimen of dry gangrene, being perfect in all its parts, although shrivelled, dry, and hard, resembling the foot of a mummy rather than any animal substance which had ever suffered from the putrefactive process. In all these cases the toes, and then the feet, became cold, powerless, and slightly tumid; they then assumed a livid hue, and afterwards changed to black, and when not kept hot and moist, dried rather than putrefied. Most of these cases proved fatal; indeed the mortality from this fever was otherwise very great, and the surgical treatment of the feet was of course always subordinate to the medical treatment of the febrile disease.

Mortification occurs, by no means unfrequently, from cold on military service; it is very analogous to that which I have been last describing, and is not, in my opinion, satisfactorily explained. The effects of cold on the French army after the battle of Eylau, are well described by the Baron Larrey, in his Campaign in Poland, vol. iii, p. 60; but the narration does not notice so much the direct effects of cold, as the results which followed its application; and he concludes that cold is not an exciting, but only a predisposing cause of inflammation and gangrene, which is true, as far as regards the gangrene which follows inflammation; but incorrect with relation to the actual death of a part, or of the whole, of the body, which occurs without inflammation.

As far as I am able to judge, from observations I have had an opportunity of making in North America, the effects of cold have not been sufficiently considered, with due relation to its different states of mildness or severity; and on reading over the very able statements of Dr. Thomson, in his Lectures on Inflammation, and of Mr. Samuel Cooper, in his First Lines of the Practice of Surgery, in which they have collated the best authorities on the subject, I am the more confirmed in this opinion, inasmuch as the different accounts of the effects of cold, therein mentioned, can only be reconciled by such proceeding, and the different

opinions as to cold being stimulant or sedative be thoroughly understood.

The stimulant effects of cold, in the sense in which it is generally understood, extend no further, properly speaking, than when they exert a beneficial influence on the human frame, although it cannot be denied, that the continued application of cold, in a moderate degree, may act as a stimulant, and cause an increased and dangerous action in a part long after the cold has ceased to be applied; and this effect will follow the application of cold, which has been augmented to a degree in which its stimulant properties are not perceptible, and it appears to act directly as a sedative. Hence the difficulty of deciding on the limits to be given to the stimulating and sedative properties of cold.

The symptoms and appearances attending the application of cold, or the abstraction of heat, are well known, as far as this abstraction is agreeable to the system, and produces healthy and renovating effects on the constitution. I shall only consider the effect of cold in a greater degree, as relating to my present subject. The human body enjoys the singular property of being able to resist cold and heat (in the common acceptation of the words) in an extraordinary degree, provided that the augmentation or abstraction of heat be made in a gradual manner, and the temperature of the body, during the augmentation, is increased but three or four degrees beyond the natural state, or about 98 of Fahrenheit. Instances are related of persons exposing themselves to a heat of 290 degrees for several minutes with impunity *; and by habit, persons can be brought to bear intense cold for a certain time without detriment. We find this to be the case in Russia, in North America, and other parts; but there is yet a degree of cold which neither man nor other animals can resist, and we find that all living creatures retire

* See the observations of Sir C. Blagden and Dr. Fordyce, Phil. Trans. and Rees's Cyclopædia, article Cold.

before it to a more genial climate. In British North America the effects of cold, usually demonstrated frost-bite, are seldom observed, unless the thermometer has fallen below zero; and under circumstances of common exposure, frost-bitten persons are rarely met with, unless the mercury has fallen ten degrees below it, or from forty to fifty degrees below the freezing point. At this degree of temperature, animals are not alone the sufferers, its effects may be seen and heard around. The trees of the forest crack and split with a loud noise, the surface of the sea seems covered with steam, as if it were actually boiling, every animal, bird, or reptile hides itself; man alone remains for a time unshaken. If there be no wind the sea freezes, and a greater degree of thermometrical cold can be borne without injury, than if there be a high wind, which is always from the north, and is called, from its effects, the *barber*, and which, by agitating the sea, prevents it from freezing. When this degree of cold is accompanied by a high north-west wind, man can no longer resist it, the evolution of caloric, however great it may be, is not equal to the rapid abstraction of it, and the extreme parts of the body become frost-bitten. I once saw the 29th regiment marched about three quarters of a mile to church, with the men's faces opposed to the *barber*, and when they arrived at the church door nearly fifty men had their noses, ears, and fingers frost-bitten. The scene was rather ludicrous, for no one was sensible of what had befallen him, one called to another, that his nose or ears were frost-bitten, and the parties then challenged, mutually armed themselves with a handful of snow, and getting under the shelter of the church, rubbed each other until the circulation and sensibility were restored. At this time it unfortunately happened that a party, consisting of a sergeant and a dozen men, were sent out after two men who had deserted a day or two before, and were exposed to the inclemency of the weather a great part of the night of the day alluded to. Two men were frozen to death, one lost both legs, and the remainder suffered severely. The effects of

cold locally, at this low degree of temperature, combined with the rapid exhaustion of caloric, are the deprivation of the sensibility and circulation of the part in so sudden a manner, as to be unaccompanied by the consciousness of the patient, further than, on attempting to move the part affected, he finds himself incompetent to do it, and on inspection perceives that it is of a dead white colour, very much resembling that of a tallow candle. If he should have a ring on a finger affected, it will fall off from the shrinking of the part. If the exposure be continued, the whole limb assumes the same appearance, the patient sits down, feels benumbed all over, lies down and dies. After death the body becomes so stiff that it may be sawed, but cannot be cut, yet does not change colour; no reaction, no mortification has taken place, but the death of the whole from the general deprivation of life. If a part of the body only be affected, the arteries of that part contract from the first, the veins are not dilated, as they are after the moderate application of cold, but are diminished; whilst the blood retires into the larger and deeper vessels, where it becomes congealed. When a limb has been fairly frozen in this way, I do not believe it can recover without suffering great detriment, and if it should have been frozen for an hour or two, I do not believe that recovery is possible. The limb will mortify. The stories then related by Richter and others, of recovery from a generally frozen state of the body, are either fables, or great exaggerations. It is possible they may have been, in truth, nearly in the same state as the lad whose case is described by Dr. Kellie, in the first volume of Dr. Duncan's Medical and Surgical Journal. He says, "When we arrived he was stretched out before the fire on his back, with very little appearance of life; the whole body, with the exception of the face, which was well coloured, was of a deadly pale appearance, and very cold. The powers of sensation and of muscular motion were completely suspended. The head and limbs, perfectly flexible, fell lifeless to the ground, from whatever position they were raised to;

the mouth was half open, and the jaw, obedient only to the hand, could be moved upwards and downwards, but returned to the half-closed position; the inspiration was obscure and insensible; but the pulse was quite distinct, even at the wrist, although irregular and slow. The organs of sense were equally inexcitable; a candle held close to the exposed eyes made no impression, the eyeballs remained fixed and motionless; the pupils, though dilated, contracted irregularly, while yet exposed to the light, in the way I have sometimes observed them do in the recently dead."

This was evidently a case occurring from the long-continued application of a moderate degree of cold, combined with fatigue, hunger, and moisture; and the symptoms which attended it are not to be considered as those arising from the application of intense cold.

I have shown that intense cold, when combined with the more rapid abstraction of caloric, by means of a high wind, causes the almost sudden death of a part, and of the whole of the body, if it be exposed to it for a sufficient time. The facts mentioned by Messrs. Parat and Martin, in the first volume of the Memoirs of the Medical Society at Lyons, 1798, may be accounted for by attending to this circumstance. They say "that the French soldiers who were employed in driving the Piedmontese from their entrenchments in the Alps, suffered more in their pulmonary organs than in their extremities. The mouth and nose involuntarily contracted, the respiration became suspended, and when the patient made an effort to distend his chest, the keenness of the air and a sensation of cold prevented him." They further say, "if the storm, instead of ceasing, is redoubled, if the person cannot protect himself by a change of position, or if he cannot weaken the force of the blast by placing his hand before his mouth; in a word, if his respiration remains for any length of time suspended, his head soon becomes giddy, he falls down, or is swept away by the blast, and soon finds a tomb under the snow which the winds rapidly accumulate over him."

This is clearly a case of death from the effects of a cold wind on the lungs, not from absolute cold. If it be said to be from cold, as well may a person caught in the desert of Arabia in a *Siroc* wind be said to die of heat, or that he is burned to death.

Maupertuis, during a winter residence at Tornea in Sweden, found that the spirit of wine in the thermometer froze, and that when the door of a warm room was opened, the external air, on rushing in, immediately converted the vapour of their breaths into whirling clouds of snow. At this time they felt as if their breaths had been rent asunder. They were every moment startled and alarmed by the loud noises, which the bursting and cracking of the wood by the cold occasioned in every part of their houses. They saw several persons who had lost legs and arms from cold; and if Maupertuis had been exposed out of doors, he would have found more injurious consequences follow its external, than what may be termed its internal application; that is, he would have certainly been frozen to death.

When cold of the intensity of from 45 to 50 degrees below the freezing point is applied without a high wind acting on the body at the same time, or only in a moderate degree, the effects of it are often more general than local; and the account given in the second volume of Dr. Hawkesworth's edition of Cook's Voyage round the World, the effects produced on Dr. Solander and the late Sir J. Banks, is applicable to every case of the same kind.

"At the time when Captain Cook lay off Tierra del Fuego, Mr. Banks (late Sir Joseph) and Dr. Solander, with other ten men, went on shore, with a view to penetrate as far as they could into the country, and to return that evening. After various hardships, and after having travelled through swamps for a considerable way, the weather, which had been very fine, became gloomy and cold, with sudden blasts of a piercing wind, accompanied by snow. Before they had accomplished their object, the day was so far spent that it was

found impossible to get back to the ship before next morning. This being their situation, it was proposed to push through a swamp that lay in their way into the shelter of a wood, and there to build their wig-wams and kindle their fire. It was now eight o'clock in the evening, and Mr. Banks undertook to bring up the rear. Dr. Solander, who had more than once crossed the mountains which divide Sweden from Norway, and who well knew that extreme cold, especially when joined with fatigue, produces a torpor and sleepiness that are almost irresistible, conjured the company to keep moving, whatever pain it might cost them, and whatever relief they might be promised by an inclination to rest. 'Whoever sits down,' said he, 'will sleep; and whoever sleeps, will wake no more.' Thus admonished and alarmed, they set forward; but they had not gone far before the cold became suddenly so intense as to produce the effects that had been most dreaded. Dr. Solander was the first who felt the inclination, against which he had warned others, irresistible, and insisted upon being suffered to lie down. Mr. Banks entreated and remonstrated with him in vain; down he lay upon the ground, though it was covered ith snow; and it was with much difficulty that his friend kept him from sleeping. One of the black servants began to linger in the same manner with Dr. Solander. After much persuasion and entreaty, they were dragged on a little way; but they again both declared they would go no further. The black servant was then told, that if he did not go on he must be frozen to death; but to this his answer was, that he desired nothing but to lie down and die. The Doctor said, he was willing to go on, but that he must first take some sleep; though he had but a short while before told the company that to sleep was to perish. They were both suffered to sit down; and in a few minutes they fell into a profound sleep. After Dr. Solander had slept about five minutes, Mr. Banks endeavoured to awake him, and happily succeeded; but, it being impossible to make the servant stir, two people were left along with him, to bring him forward, as soon as he could be roused.

Of the three that were left in this situation, it is sufficient to say that only one survived, and that he too seems to have been preserved by leaving his charge, coming soon to join the company, and by partaking of the benefit of their warm fire."

When the cold in North America attains to this degree of intensity, the sentries on duty do not become frost-bitten, unless there be a high wind, but they become affected with such a degree of torpor or sleepiness, that they cannot resist the impulse of standing up in the sentry-box, which they are forbidden to do, because the instant they do so they fall asleep, and are frost-bitten or frozen to death. To prevent this, the sentries are relieved every half hour instead of standing the usual time of two hours; and whenever they feel this propensity to sleep coming on, they are ordered to give the alarm, that they may be relieved, and additional communicating sentries are placed for the purpose, or the corporal of the guard visits each sentry every ten minutes. Proper instructions are given in case of accident; and although sleeping on sentry is the greatest crime a sentry can be guilty of, except deserting, no officer would think of punishing a man who fell asleep under these circumstances.

Dr. Thomson says, page 624, "It is doubtful, however, how far the state of sleep is the necessary consequence of simple exposure to cold; or at least, what other circumstances besides cold are necessary for its production, since this exposure may be made to an intense degree of cold, for a considerable length of time, without sleep being induced." He instances in support of this opinion, the cases of Elizabeth Woodcock, who was buried in snow for eight days, near Cambridge, in 1799, and remained sensible the whole time; and some sailors, who were shipwrecked, and were kept for twenty-three hours in the water at a very low temperature without being drowsy; but neither of the facts bears on the question of the application of intense cold *. It is well known

* When the cold is so intense as I have just described, or the thermometer is at 45 degrees below the freezing point, water freezes before

to all philosophers and practical chemists, that a thermometer plunged into snow does not fall to a degree indicating any thing like intense cold; and, when they want to produce it, they add salt, &c. for the purpose of effecting it. I conceive then, from what I have said, and the facts I have related, that I am authorized in saying that a state of sleep is a necessary consequence of exposure to intense cold.

In regard to the capability of bearing cold, the Baron Larrey has said, page 125 of his fourth volume, that, "in the late disastrous campaign in Russia, individuals of a brown complexion, mostly born in the southern provinces of Europe, bore the cold better than fair persons born in northern countries; that of the Dutch grenadiers of the guard, consisting of 1787 men, only 41 returned, whilst of the two other regiments of grenadiers, composed of men who were nearly all born in the south of France, a considerable number were saved. The Germans also lost, in proportion to their number, many more than the French." The Baron attributes this difference to the greater courage and exertion of the French; and he is at liberty to compliment his countrymen as much as he pleases; but I deny the fact, having invariably found the natives of warm climates suffer much more than those from cold. During the siege of Ciudad Rodrigo, the troops were obliged to sleep on the ground, without cover, and one night, when it froze hard, three of the Portuguese actually died of it, whilst the British escaped without being frost-bitten. In the expedition to New Orleans, a regiment of blacks was sent from Jamaica to augment the number of troops; but when the cold weather set in, the men were not only found incapable of doing any thing, but many of them were actually frozen, and several lost their hands, feet, and legs, from

the fire, and the fire-irons are so cold, although in contact with the chimney, as to burn the fingers, as it is termed, when touched; that is, the metal causes so sudden an abstraction of heat, that vesications arise a short time afterwards, from the reaction. Mercury, when solid from cold, is not bearable on the palm of the hand.

mortification. There was some time back in the Detachment Hospital at Chelsea, in charge of Mr. Burmester, a man, born in Hindostan, of a native woman, but an European father, who had actually lost his feet from cold in this country, and whilst in regimental hospital. His feet became at first benumbed, and swelled; and, after several days, it was discovered that they were black and gangrenous; but from such an occurrence being unsuspected, too late to afford relief.

Cold applied in a more moderate degree, does not cause in a direct manner the part to be frost-bitten, so as to assume the dead white appearance I have described, or to become seuseless and motionless; the persons affected are capable of moving about, and of resisting the effects of cold, although incapable of sustaining those produced by a sudden change of temperature. They are nearly in the state of those who have been frost-bitten, and who, after having partially recovered, are too suddenly removed into warm rooms. It is the effect of the application of a more moderate degree of cold, for a greater length of time, exhausting thereby the powers of the part, and rendering it incapable of supporting any reaction which may afterwards take place. The case of Elizabeth Woodcock, alluded to page 146, is of this kind; and the French army, after the battle of Eylau, suffered in the same manner. During the continuance of the cold, the troops moved about and felt little inconvenience from it; but as soon as a thaw took place, reaction commenced; the vessels became distended with blood, which they were incapable of circulating; the limb assumed a livid hue from the congestion, became tumefied, black, and fell into a state of mortification, which at this time was local, but which after a short period would become constitutional.

From these premises I consider myself authorized to conclude legitimately, that intense cold destroys the vitality of a part without any reaction taking place; but that cold, applied in a more moderate degree, only impairs the vitality of a part, yet frequently to such an extent, that it is unable to exist,

when reaction takes place; and more especially if it be too rapidly induced.

The question of amputation hinges here, on the same principles as in other instances of local gangrene; and when mortification is fairly established, there can be no doubt of the propriety of removing the limb, as soon as the patient is in a state to admit of it, and without any line of separation being established. If, however, an improper delay has taken place, and the system at large has become affected, the surgeon should wait for the cessation of the mortification before he proceeds to operate.

When a part has been frost-bitten, the best application is snow rubbed on it with the hand, the heat of which gradually melts the snow, and warms the part in a slow but regular manner; and as it becomes warmer the friction may be greater, and the application changed to water, or combined with a little spirit. This must be done in a room without a fire, and the patient in no manner exposed to a high or even a moderate temperature. As he recovers the use of the part, or his senses, a light warm cordial should be ordered, he should be put to bed in a room without fire, and some warm, but watery drink given. The body may be well rubbed, and perspiration excited by the usual means; tobacco injections are highly improper, although stimulant enemas may be serviceable. Under the most favourable circumstances, slight vesications generally take place, the part tingles, as it is called, for some time, and is, during the rest of the season, much more sensible to cold.

After the line of separation has been drawn, and the dead parts are nearly thrown off, gangrenous inflammation often again takes place without any evident cause. This occurrence is generally a fatal one. That amputation will sometimes here save the patient, the following case, communicated to me by Staff-surgeon Bruce, now surgeon at Ripon, in Yorkshire, will testify. Private Laws, of the 40th regiment, during the expedition to New Orleans, was frost-bitten in the right foot, and reached the hospital-ship on the 28th of January 1815.

The mortification of the foot was complete; wine, bark, brandy, &c. were administered, and poultices were applied. Under this treatment the separation of the foot was going on; and, on the 4th of February, the astragalus was loose and partly detached. On the evening of that day, the inflammation assumed a darker colour, and was attended by a burning pain, which increased, and, on the 9th, mortification was spreading rapidly up the leg. He passed a restless night, was at times delirious, and covered with perspiration, pulse feeble and very weak, the tongue brown and dry, suffered much from thirst, and begged to have his leg cut off. The operation was performed on the 10th, above the knee; he lost little blood, and observed, shortly after the operation, that he felt more comfortable than at any period since he was frost-bitten. On the 26th of the month, the ligatures had all separated, the stump was healing fast, and the man was sent to England, in the Bedford man of war.

I may here be permitted to confirm the old remark, that gangrene often takes place without sufficient apparent reason, ceases in the same manner, and as readily recurs. The prognosis, in every case, should then be very guarded, until the mortified parts are completely separated; and even then, should not be too confidently given as to the certainty of its future non-appearance.

Gangrene from pressure is by no means an unfrequent occurrence after wounds, in consequence of confinement to bed. I have known many cases lost by it when the wounds were going on in a favourable manner. It generally occurs from weakness of part, sometimes from the stimulus of the urine, which, in cases of paralysis, is capable, when combined with pressure, of inducing it in a few hours. The part pressed on, first looks red, then black, and dies, with little surrounding inflammation. No application that I am acquainted with is of any use in arresting its progress, unless the pressure be removed and the part kept dry, and a cushion made with a hole to receive it, when the mortification will cease. I have

seldom known it spread beyond the part which sustained the pressure; and in bad cases, the sacrum, the tuberosities of the ischium, and the trochanters should be defended in this manner.

Having endeavoured to establish the principles on which mortification is supposed to depend, it will be unnecessary to enter in detail into the treatment. In all cases, except in excess of inflammation, the internal means should be to sooth and support the system. Bark I have not found useful, further than as a tonic, and given in such quantities as not to overload the stomach *. Camphor, the carbonate of ammonia, opium, wine, brandy, I conceive to be better remedies. As topical applications, emollient and fermenting poultices are decidedly the best, alternating with mild spirituous fomentations. I have always seen scarifications do harm, when they approached or interfered with living parts, and stimulant applications are only admissible, on the common principles of surgery, as applicable to parts in a state of ulceration. Any thing, however, which keeps them clean, and tends to remove or destroy the fetor from those which are dead, is beneficial.

The following Reports, No. I, II, III, and IV, will confirm several of the statements I have made, and may be satisfactory on other points. Nos. I and II are returns of officers and soldiers treated after the battle of Toulouse, classed according to the nature of the wounds. In the first ten weeks, one-eighth of the whole died, and one-eighth more may be considered as dying afterwards, or as being unfit for service; the permanent loss after a battle to the effective strength, varying from one-fourth to one-third of the whole number wounded. Of 1359 cases treated, including officers, only one artery required a ligature; the other cases of secondary hæmorrhage having occurred as complications of compound fracture, rendering am-

* The sulphate of quinine has now superseded the use of the cinchona in substance, and is a much more efficient remedy.

putation necessary; facts which are strongly confirmative of the statements made as to secondary hæmorrhage at page 8.

The difference of loss between the officers and private soldiers is rather remarkable, and cannot readily be accounted for. The wounds were certainly not so severe, as may be seen by comparing the tables, the officers being to the private soldiers nearly as one to eleven. In regard to the surgical treatment, I can conscientiously say the officers were not more regularly attended than the privates, neither were the surgeons more able men. The very same kind of indulgences, as to quality and quantity, were supplied to both; and although the separate apartments of the officers might make some difference, it could not be to any extent.

No. III is the first weekly report of the largest hospital, containing 470 men, and will show the precision with which the duties were performed, and the attention paid to the several cases: it confirms the statement made as to erysipelas, page 104.

No. IV is a report of the same hospital at the end of five weeks, when nearly all the wounded had been transferred to Bordeaux, by the river Garonne, in a favourable state, and is a very instructive document.

The remaining hospitals, containing about 250 men each, were in charge of Staff-surgeons Burmester, Dumoulin, Mathews, and Dease. The officers were in charge of Staff-surgeon Murray, who had the benefit of the advice of Mr Gunning, Surgeon in chief; and I saw all the cases among them of importance, as they were objects of my particular attention.

In regard to the hospitals, the medical officers commenced their duties at six o'clock in the morning, at which time I always visited one of them, and was expected by all, and again at the same hour in the evening; so that almost every case of importance came under my inspection daily, and more especially those at the Caserne de Calvete, Letter A, on which account I have selected the returns of that hospital.

No. I.

Return of Surgical Cases treated, and capital Operations performed, in the General Hospital at Toulouse, from 10th April to 28th June 1814.

Diseases and State of Wounds.	Total treated.	Died.	Discharged to Duty.	Transferred to Bordeaux.	Proportion of Deaths to the number treated.
Head	95	17	25	53	1 in $5\frac{10}{17}$
Thorax	96	35	14	47	1 in $2\frac{35}{96}$
Abdomen	104	24	21	59	1 in $4\frac{1}{4}$
Superior Extremities	304	3	96	205	1 in 101
Inferior ditto	498	21	150	327	1 in $23\frac{5}{7}$
Compound Fractures. Gangrene.	78	29	—	49	1 in $2\frac{29}{29}$
Wounds of Spine	3	3	—	—	1 in 1
Ditto of Joints	16	4	—	12	1 in 4
Amputations: Arm 7 / Leg and Thigh 41	48	10	—	38	1 in $5\frac{1}{3}$
Total	1242	146	306	790	1 in $8\frac{128}{145}$

Wounded Officers ... 117, not included.

Among these, 13 cases of tetanus occurred; all proved fatal.

Secondary Operations.	Total treated.	Died.	Discharged.	Transferred to Bordeaux.
Amputation of superior Exrremities	15	3	—	12
Ditto of inferior ditto	37	18	—	19
Operation of taking up the Femoral Artery	—	1		
Trephine	4	3	—	1
Shoulder Joint	1	1		
Total	58	26	—	32

Of the 48 primary operations, 10 died; of these, 3 of the thigh within a short time after the operation, being as high up as could

be performed by the common operation. Forty-one of the operations were of the thigh and leg, 7 of the arm.

Of the secondary operations: of 15 of the superior extremity 3 were lost, and of 37 of the thigh 18 died.

Of fractures of the thigh there were 43; of these,

20 died, 7 having suffered amputation.
5 were amputated.
18 cured and under treatment.

Total ... 43

Of the 18 cured and under treatment, 5 only can be considered well, or as using their limbs. Two more consider their limbs more valuable, or serviceable, than a wooden leg; and the remaining 11 wish they had been amputated at first, as they are not likely to do well; and if they recover, the limbs will be distorted and unserviceable.

No. II.

Return of surgical Cases treated, and capital Operations performed, amongst officers at Toulouse, from the 10th April to the 28th June 1814.

Diseases and State of Wounds.	Remained.	Admitted.	Total treated.	Discharged.	Transferred to Bordeaux.	Died.	Remaining.	Proportion of Deaths to the number treated.
Head	-	6	6	4	1	—	1	
Thorax.....	-	10	10	2	2	—	6	
Abdomen	-	1	1	—	—	—	1	
Superior Extremities..	-	33	33	9	15	—	9	
Inferior	-	49	49	12	21	1	15	1 in 49
Compound Fractures .	-	7	7	—	1	2	4	1 in $3\frac{1}{2}$
Slight Wounds.....	-	11	11	7	2	—	2	
Gangrene.								
Total...	-	117	117	34	42	3	38	1 in 40

Secondary Operations.	Total treated.	Discharged.	Transferred to Bordeaux.	Died.	Remaining.	
Amputation of Superior Extremities	1	—	—	-	1	
Inferior.....	4	—	—	1	3	
Tetanus occurred	—	—	—	-	-	1 died.
Total ...	5	—	—	1	4	

The officers in the column remaining were permitted to find their way to Bordeaux at their own convenience.

No. III.

Weekly Report, Letter A Division.

Toulouse, April 21st, 1814.

The Caserne de Calvete, or Letter A Division, has been only one week established, and contains chiefly the wounded of the 4th and 6th divisions, who suffered in the actions near this city, on the 10th instant. The total admitted is 470, of which number nineteen have died: eight proved fatal almost immediately after their being brought into hospital, and no minutes of their cases were preserved; of the remaining eleven, two were cases of mortification supervening on compound fracture; two of tetanus supervening on wounds of the lower extremity; two amputations of the thigh, one performed on the field and the other in hospital; three were wounds penetrating the cavity of the thorax; one a wound entering the abdomen; and one a wound of the spine.

The number of amputations in hospital amounts to near thirty; and with the exception of three or four, in which there is unhealthy action from constitutional irritation, they are doing remarkably well; three amputations only have as yet been performed since the establishment of the hospital; no shoulder or hip case whatever has presented itself.

There are twelve cases of injury of the head; in all of them there is either fracture, or denudation of the bone; in one instance only has it been necessary to use the trephine; two cases have required extensive dilatation, and the removal of loose and depressed portions of bone; one terminated fatally; the other is apparently doing well; from the insidious nature of this species of wound, the most marked attention is required to be paid to the state of the pulse and bowels, and the antiphlogistic plan is rigidly pursued with the whole of them.

The wounds of the thorax are numerous; in about twenty cases, musket-balls have passed through, or lodged within the cavity; in three of them an unfavourable termination may be

speedily expected ; about the same number may be considered dangerous ; and the remainder hold out the hope of eventua recovery.

There are a few cases of wounds of the abdomen ; the inflammatory symptoms have been subdued, and they all promise to terminate favourably.

The compound fractures amount to near thirty ; those of the leg and upper extremity are going on well ; the thigh cases, as usual, are very severe, and their issue of course doubtful ; they are placed in the extended position, and the utmost attention is paid to the personal cleanliness of the patient.

There are many cases of wounds of joints, or where the site of the wound being in the neighbourhood of a joint, the inflammation has extended to the cavity ; the inflammatory symptoms have been kept down as much as possible ; in several of these the propriety of removing the limb will be a subject for serious and necessary consideration.

Two cases of hæmorrhage only have occurred ; one from the profunda, in a case of compound fracture, which required amputation of the limb ; the second from a branch of the internal iliac, the patient having been wounded by a musket-ball, immediately at the junction of the sacrum with the os coccygis : the bleeding was stopped by the graduated compress, but the issue is still very doubtful.

One case only of erysipelatous inflammation supervening on gun-shot wound has been observed ; it has been successfully treated by bleeding, cathartics, antimonials, and the antiphlogistic regimen.

The remaining cases are flesh wounds, some of them very severe, but the whole are at present under the influence of a perfectly healthy action, and promise a very speedy recovery.

CHARLES BOUTFLOWER,
Surgeon to the Forces.

No. IV.—Return of Surgical Cases treated, and Capital Operations performed, in Letter A General Hospital, Toulouse, in charge of Staff Surgeon Boutflower, from April 10 to May 16, 1814, inclusive.

Diseases and State of Wounds on Admission.	Remained.	Admitted.	Total treated.	Discharged to Duty.	Transferred to Pordeaux.	Died.	Remain.	Proportion of Deaths to Diseases treated.	Remarks.
Head	—	12	12	—	2	6	4	1 to 2	Two died the day of admission; one after being trephined: the remaining three from inflammation and suppuration in the substance of the brain: in the whole, the cranium was more or less fractured.
Thorax	—	26	26	—	5	14	7	1 to 2	Three died the day of admission; many of the remainder were complicated with other severe wounds.
Abdomen	—	10	10	—	2	7	1	2 to 3	Three died the day of admission.
Wounds of the Spine	—	3	3	—	—	3	—	1 to 1	In all there was paralysis of the lower extremities; one died on the eighth, a second on the fourteenth, and the other on the fifteenth day.
Wounds of Joints	—	16	16	—	2	4	10	1 to 4	Two were admitted in a state of mortification, and died on the seventh day; one died after amputation; the fourth was a wound of the hip-joint, not admitting of amputation.
Compound Fractures	—	25	25	—	2	7	16	1 to 3½	On two amputation was performed very high on the thigh, after considerable hæmorrhage; a third was carried off by pneumonia.
Amputations	—	26	26	—	16	4	6	1 to 6½	In one case there was secondary hæmorrhage; the remaining three had fever, of the bilious remittent type.
General Wounds (severe)	—	270	270	36	212	8	14	1 to 34	Five were cases of tetanus supervening on wounds of the foot.
Ditto, Ditto (slight)	—	82	82	70	11	1	—	1 to 82	This was a case of enteritis.
Total	—	470	470	106	252	54	58	1 to 8	

Secondary Operations.	Total Number.	Died.	Discharged	Under Treatment.	Remarks.
Trephine	1	1	—	—	Died twenty-four hours after the operation.
Amputation, Upper Extremities	6	1	—	5	Attacked with bilious fever the day after the operation, died on the seventh day.
Ditto, Lower Ditto	9	4	—	5	In one amputation was performed after the tetanus had occurred: two were amputated very high in the thigh, the femur being broken, and the artery having given way: the remaining one sunk under bilious remittent fever.
Total	16	6	—	10	

Five cases of tetanus occurred: in one, the cold bath was the principal remedy; in the second, amputation was performed; in the third, the warm bath and pulv. ipecac. comp. were used; in the fourth case, opium and ether in excessive quantities were exhibited; and in the fifth, the tinct. digitalis and bleeding were adopted: the result in all was fatal.

2. ON GUN-SHOT WOUNDS,

Accompanied by Lesion of the larger Nerves.

When an injury has been inflicted upon one of the larger nerves of the body, peculiar symptoms follow, which are generally referrible to parts distant from the seat of injury, and are entirely dependent, as to their nature, on the extent of the nervous affection. The sufferings of the patient are of two kinds, from deficiency or excess of sensibility; and between these two extremes, there are of course several intermediate stages. It has fallen to my lot to see a great many wounds of this description, and several of them have been productive of the greatest suffering for years. When a large nerve is injured, the pain or inconvenience which arises is not felt at the place of injury, but in the part to which the nerve is distributed. If it be completely divided, the effect produced is, total loss of sensation and motion in the part supplied by it. If, on the contrary, the nerve be only injured, the effect is pain in the part supplied, which has a greater susceptibility for stimuli than natural, with diminished capability of bearing them, partial loss of sensation, and a greater loss of the power of motion. The part of the nerve actually injured offers little or no impediment to the healing of the wound, which is generally effected in the usual time. Such is the outline of a case of this description; and at page 22 I have alluded to it, with reference to the seat and nature of the attendant pain. The consequences which follow may be local or general; and whether they be one or the other, are frequently almost unbearable, and certainly productive of much distress.

When the great nerve, or all the nerves going to a part or extremity are divided, the whole of the limb is deprived of the power of motion and sensation; it swings by the side of the body like a pendulum, according to the impulse communicated to it from external agents; or it remains in the position in which it may happen to be placed, until it is again removed.

The circulation of blood through it continues, as far as can be observed, perfectly unimpaired, although the size of the vessels appears to be diminished; the pulse of the affected side not being so strong as that of the sound extremity. The limb is shrunk, the muscles being greatly diminished, the deposition of fat comparatively trifling, and the skin loose. The temperature is always lower than that of the sound limb by several degrees, and the change from heat to cold, or the reduction of it, is more readily effected. The power of resisting heat or cold, which is inherent in a natural state of the human body in an eminent degree, seems to be nearly destroyed, and the sufferer is in danger of being scalded, or frost-bitten, from applications which produce no unusual effect on parts in a healthy state. The circulation in the smaller and capillary vessels is of course easily obstructed, although the arteries and veins perform their functions, in consequence of a vitality or power they possess independently of the usual and common nervous influence sent to the limb by the nerves belonging to it. Whether this be aided by the ramifications of the great sympathetic, which Chaussier and Ribes have described as accompanying the arteries to their extreme branches, I know not; but it would seem to be insufficient, from whatever source it may be derived, to maintain the several smaller vessels in all their integrity, inasmuch as they are incapable of supporting the application of stimuli, mechanical or chemical, and of acting in their usual manner when in a perfectly healthy state. The process of inflammation is not carried on in the same way as in health, it more rapidly passes over the adhesive stage and runs on to the ulcerative; it is not, however, so prone to pass into the gangrenous state as in paralysis from internal causes, from which, in this particular, there is a considerable difference. The absorbent system seems also, like the sanguiferous, to be in a great measure independent of the nerves going to the part, and its functions to be performed with regularity. It is possible, indeed almost evident, that the duties of this system are much diminished, and probably in due pro-

portion with the deficiency in the actions of the smaller vessels of the sanguiferous system, but not, as far as I can judge, in so great a degree as in paralysis. Lastly, when the complaint is local, the health of the person, and the appearance of the frame generally, with the exception of the part affected, are not deteriorated, and the usual functions of the body are unimpaired, which is not the case in paralysis from internal causes.

An officer received two balls at the battle of Salamanca: one passed through the knee-joint, the other through the upper part of the chest, near the shoulder, but underneath the clavicle, dividing, as was supposed, the nerves going to the left arm, which was immediately deprived of the powers of sensation and motion. Suppuration occurred in the knee-joint, inflammation had taken place in the chest, he had a very troublesome cough, hectic fever had supervened, and this gentleman seemed to be almost without hope, when my opinion was requested. It appeared to me, after careful examination, although the lung of the left side had been affected by continuity of inflammation, and was still suffering from its consequences, that the hectic fever had principally been caused by the disease of the knee-joint, the amputation of which offered the only chance of relief. This appeared to be, and was, a very strong measure; but no intermediate one could be resorted to with any hope of success; and, after having the true state of the case made known to him, the patient decided that he would have his leg removed above the knee. The operation was done, and succeeded. He slowly recovered, and the wounds healed, but the arm remained in the state I have described. Fourteen years have elapsed, and he is now grown stout, is in excellent health, but the arm remains nearly the same. He has within the last eight years perceived some sensation in the course of the muscular or spiral nerve. He has also been indicted for a rape; but the magistrates, very properly, however they might admit the attempt, would not consent to the admission of the fact.

When there are several nerves supplying different parts of a limb, the DIVISION of one of the trunks produces no further inconvenience than that which arises from the loss of sensation and motion in the part to which the ultimate ramifications are distributed. This is particularly the case in the arm, to which several large branches are sent, one of which may be divided without causing any affection of the rest. It also seems possible, that, in such cases, the nerve may be regenerated, although it is an extremely rare occurrence after a gun-shot injury. A soldier, at the battle of Albuhera, received a ball on the inside of the arm, which divided the ulnar nerve, and caused an immediate paralysis of the little, and of one side of the ring finger, which remained a permanent inability. Another soldier, of the 48th regiment, received a similar wound on the same day, and affecting the same parts. The nerve, it would appear, was not however completely divided, although it must have been nearly so, for he suffered considerable pain at first in these two fingers and in the hand; this, however, soon subsided; and four years afterwards, when I accidentally saw him, I found that he had recovered the use of his fingers, although he complained of the want of power in them, when compared with their former state, and their liability to suffer in a greater degree from any considerable change of temperature.

Wounds or injuries which do not entirely divide the trunk, or branch of the nerve, are attended by symptoms and consequences of a much more important nature, which may be considered as local, or general: local, when affecting the nerve or nerves immediately injured; and constitutional or general, when by sympathy, or continuity of disease, other nerves and other organs of the body become affected.

A soldier received, at the battle of Waterloo, a wound in the back part of the thigh, which stunned him at the moment, but was shortly followed by considerable pain, not in the part actually injured, but on the outside of the leg below the knee, in the sole of the foot, and in the toes. This pain gradually

increased rather than diminished, became at times intolerable, and rendered the sufferer's life miserable. It seemed to increase by paroxysms, during which the man was in agony; the pain not only being permanently intense in the foot, but darting down to it, and accompanied by spasms of the whole extremity. No kind of medicine had any effect upon it; and at these periods the poor fellow found relief only by putting his foot on a cold stone, or by enveloping it in cloths wet with water, or the liq. plumbi subacet. dilutus. This man was discharged, without having obtained any permanent benefit, although from habit he became less sensible of the pain, and more accustomed to the necessity of jumping out of bed, and placing his foot on a stone, or of keeping it constantly wet and cold.

An officer of the Rifle Brigade was wounded at Waterloo, nearly in the same manner, and has suffered since with corresponding symptoms, but in a minor degree. I saw him a few weeks ago, when he came up to be examined for his pension, and he was still lame, in consequence of the limb being deficient in power, thereby rendering him incapable of taking more than very moderate exercise. The pain experienced by this gentleman was never so permanently acute, neither were the paroxysms equally severe, although he is still subject to them. There is, however, this marked difference between the cases, that the gentleman could not bear the application of cold, which always increased the pain, whilst in the soldier it invariably afforded relief. In this respect the case of the soldier is peculiar, for, out of a number of persons who have sustained this kind of injury, I have not met with another, who obtained decided relief from cold, which, on the contrary, generally did harm; and the greatest inconvenience which such persons suffer on common occasions is from cold, against which they are obliged to take especial care to guard, by the use of flannel, hare-skins, &c.

An officer of heavy cavalry was wounded at the battle of Waterloo by a piece of a shell, which lacerated the outside of the right arm above the elbow, but external, to the lower part

of the belly of the biceps flexor cubiti muscle. The wound itself gave no more pain than is commonly felt, and healed in the usual time. He suffered greatly, however, from pain in the thumb and fore-finger, and to a less extent in the second finger, but with increased violence on the back of the hand, which was sometimes intolerable, of a burning nature, always present, although frequently increased by paroxysms, and particularly so on any change of the weather. This pain prevented his sleeping, and was a source of continual distress. The thumb and fingers were powerless, and nearly insensible to the touch. The parts affected were rather swelled, and were frequently in danger of being frost-bitten, from a moderate degree of cold; and of being scalded from the application of hot water, which the other hand could bear with impunity. This gentleman is now much better, but a twelvemonth elapsed before any amendment took place, and during that period he suffered an aggravation of the pain, uneasiness, and swelling of the hand, which his physician in the country conceived to be an attack of rheumatism.

An officer of infantry received, at the same battle, a wound from a musket-ball, nearly in the same place, which was followed by similar effects, and has taken the same course. Both these gentlemen have obtained pensions; and there can be no doubt of their deserving them, although they are not incapacitated from doing their duty as field officers.

A private soldier, after the battle of Vimiera, came under my observation, with a wound from a musket-ball, as nearly as possible like the two former, and who, when I saw him, was suffering in the same way. These three cases show the effect of an injury of a nerve in a more remarkable manner than the others, inasmuch as it is not the nerve actually supplying the part affected that is injured, but one only in communication with it. The radial, or median nerve accompanying the brachial artery, supplies the thumb, fore and second fingers, and one side of the third, whilst the muscular, or spiral nerve, which must have been the principal one injured, is only par-

tially in communication with the part by its deeper seated branch.

Dr. Denmark, in the fourth volume of the Medical and Chirurgical Transactions, has related the following case, which is exactly in point.

"Henry Croft, a healthy young man, belonging to the 52d regiment, was wounded, on the night of the 6th April 1812, at the storming of Badajos. A musket-ball entered the triceps extensor cubiti, about an inch and a half above the inner condyle of the os humeri, which, grazing the inside of that bone, passed obliquely downwards through the brachialis internus, and out anteriorly near the bend of the arm. The wound soon healed, and without manifesting any particular morbid symptom during the cure. On his admission into this hospital, I found him labouring under excessive pain, which the largest opiates could not assuage, with almost constant watching. The little sleep he had, if it could be called such, was disturbed by frightful dreams and starting. I always found him with the fore-arm bent, and in the supine posture, supported by the firm grasp of the other hand; the wrist also bent, being unable to move it into any other position by the voluntary exertion of its own muscles. He could suffer me to extend the hand, but with increased pain. It always, however, on the removal of the extending power, fell into its former bent situation. The act of pronation he could also suffer me to perform, but in like manner with increase of pain. A small tumour could be felt in the site of the wound on the anterior part of the arm, which he could not bear to be touched without evincing additional torture.

"He described the sensation of pain as beginning at the extremities of the thumb and all the fingers except the little one, and extending up the arm to the part wounded. It was of a burning nature, he said, and so violent as to cause a continual perspiration from his face. He had an excoriation of the palm of the hand, from which exuded an ichorous discharge. The cause of this he ascribed to a shell rolling over it. His ago-

nies, he observed, were insufferable, depriving him of sleep, and the enjoyment of his food, for which he had sometimes an appetite. He declared himself incapable of enduring it longer without some relief, and earnestly requested the removal of the arm. Before proceeding to any operation, I recommended him to try the effect of the warm and vapour baths, anodyne embrocations, &c.: but from none of these he experienced any alleviation of his sufferings.

"The symptoms were sufficiently clear, I conceived, to lead to a correct prognosis. The part wounded, the nature of the pain, and its course from the fingers, with the exception of the little one, indicated the affection to be in the radial nerve. The increased pain, attendant on the act of pronation, further corroborated that supposition, from the pressure of the pronator teres on the nerve, in its passage through that muscle. The man said he had profuse bleeding after receiving the wound, yet the pulsation of the radial artery I found to be as strong as in the other arm. It was difficult to suppose the radial nerve wounded and the humeral artery to escape: such, however, proved to be the case.

"I proposed to my patient the possibility of saving the limb, and relieving the pain, by cutting down upon the nerve, and removing a part of it, above the wound; which he willingly consented to; but observed, that he would rather have the arm amputated at once, than run the risk of a second operation.

"In a consultation which I held with my colleagues upon the case, when we considered the chance of failure, together with the injured state of arm, and contracted elbow-joint, we determined on the propriety of amputation. I immediately performed this operation, and with instantaneous relief to my patient. He was discharged cured in three weeks, having in that time rapidly recovered both his health and strength.

"On dissecting the arm, I traced the radial nerve through the wounded parts; it seemed to be blended with and

intimately attached to them for the space of an inch. It had been wounded; and at the place of the injury, was thickened to twice its natural diameter, and seemed as if contracted in its length. This contraction I thought partly accounted for the bent position of the arm, and the increased pain on attempting its extension; but on further examination, I was surprised to find, on dividing the fibres on the posterior part of the wounded nerve, that there was a small portion of the ball firmly imbedded in it, which had been driven off by grazing the bone. This description of injury more fully accounts for the exquisite pain felt by the patient. The os humeri was discoloured where it was grazed by the ball, and the humeral artery was uninjured. The nerve was evidently thickened both above and below the wound. Would the division of the nerve, and cutting a piece of it out have been attended with success?"

Mr. Wardrop has inserted the following interesting case on the subject, in the eighth vol. of the Medical and Chirurgical Transactions: "A respectable woman, about forty-eight years of age, twelve months before she applied to me, pricked the fore-finger of her right hand, near the point, with a gooseberry thorn; it was immediately followed by a great degree of pain, swelling, and redness, and in a few days the inflammation extended along the finger and adjoining phalanx of the middle finger. After continuing nearly three months, during which time no suppuration took place, the pain and swelling went off, except that of the two first phalanxes of the wounded finger. These remained extremely painful, and, about six weeks previous to the time I saw her, her general health had suffered considerably, and she was attacked with severe nervous paroxysms. The pain in the point of the finger became excessively severe, and the skin of it so acutely sensible, that she could not endure it to be touched; even the dread of any thing coming in contact with it, would make not only the finger, but the whole hand, flow with perspiration; and, to use her own expression, 'it was so painful to the touch, she could

not hold a pin betwixt the finger and thumb, to save her life. The finger appeared of its natural form, and no change could be perceived in it, except a light red spot on the skin at the point.

"The nervous paroxysms usually attacked her two or three times a day, and one of them always came on at the time of her rising out of bed. During these attacks the pain extended along the finger to the back of the hand, and between the two bones of the fore-arm, darted through the elbow-joint, stretched up the back of the arm to the neck and head, producing a sensation at the root of the hairs as if they had become erect. To these feelings succeeded a dimness of sight, and the pain afterwards went suddenly into the stomach, followed by sickness and vomiting. She had constantly the feeling of a lump in her stomach, and always vomited after taking food or drink; her flesh, too, was much wasted, and she had become extremely feeble.

"During her illness, various cooling and astringent lotions were used without any benefit, and seven months after the accident, three incisions wore made in the point of the finger, which gave excruciating pain, but from which she received not the smallest benefit.

"As well from her own suggestion, as from the opinion I had formed of the disease, it was agreed on to amputate the finger, and accordingly this was done in the usual manner at the second joint.

"On carefully dissecting the finger, no change could be detected in the structure of the nerves.

"No sooner had she got into bed after the operation, than she experienced a remarkable difference in her feelings: the sensation of a lump in the stomach, and sickness, which she had so long felt, immediately subsided, and in half an hour after the operation, she said that she felt for the first time as well as she had done previous to the accident, except merely a slight pain in the stump.

"The greater portion of the wound healed by adhesion,

and when I saw her some weeks afterwards, her general health was completely re-established, and she never had the smallest return of any of the nervous symptoms."

He further remarks, "The success of amputation where the affection is produced from an injury of the nerve, is illustrated in the case which has now been related, as well as in that published in the fourth volume of the Transactions of this Society by Dr. Denmark. Had the nerve been merely divided, in this latter instance, as was originally proposed, and as was done in a similar case related by Sir Everard Home in the Philosophical Transactions, it is extremely probable that the operation would have been attended with the same fatal result."

Sir E. Home, in his work on Ulcers, has given the history of a spasmodic affection of the thumb, which appears to have been caused at first by a blow, but which after a time affected all the parts to the head, proceeding from the thumb in "the direct course of the trunks of the median nerve up to the head." Sir E. Home "divided the nerve, as it passes from under the annular ligament, towards the thumb and fore-finger," it having been laid bare for above an inch in length, and detached from its lateral connections; for fifteen hours no spasms were felt, but at the end of that time a violent one was experienced, and they continued from time to time for five months, when the patient died in a fit, supposed to be apoplectic.

In other cases in which I have known the radial and ulnar nerves to be injured, the pain and inability have been referred to the extreme parts supplied by them, as the thumb, and fore and second finger, when the radial nerve was affected; the little and ring finger, when the ulnar nerve had been injured. The sensation accompanying the pain has sometimes been compared to what is usually felt on striking the elbow in a particular manner against the corner of a chair, and which most persons have experienced, although few know that it arises from bruising the ulnar nerve between it and the bone. The pain

has always extended up the arm, but in much less degree, and never so far as to approach the part actually injured, in which the patient has never suffered any inconvenience. The motions of pronation or supination have been accomplished at the will of the patient, without much inconvenience; the muscles of the arm have certainly been much shrunk and wasted, liable to frequent spasms, and the fingers contracted, but by no means in the same manner as in the case described by Dr. Denmark.

It is a question, deserving of very particular attention and inquiry, whether the pain in all these cases is actually felt in the part to which it is referred, or not? although to some persons it may appear very easy to reply, more especially as there seems to be in most of them, during an increase of pain or distress, a greater flow of blood to the part. It must be recollected, that many who have had their limbs amputated, suffer for years; and some of them constantly from pain, which they say is in the part they have had removed; if, for instance, the leg has been cut off below the knee, the pain is felt so strongly as if in the ankle, that they cannot refrain, until after a moment's recollection, from putting their hand down in search of the part; and this pain is often so intolerable, that the person is actually obliged to move his stump, as he would his leg, if he had it, in order to try if that will give relief. In a case of this kind after amputation, there can be little doubt, from its continuing for years, that it occurs from undue pressure on the end of the nerve, a portion of which formerly supplied the part to which the pain is now referred. A wounded nerve may be placed, from the granulating and cicatrization of the wound, nearly under the same circumstances, and the pain may be not only brought on in a very great degree, but kept up by them. It appears to be well ascertained, that the pain accruing from a wounded nerve is not so severe on the day of the injury, as it is some days afterwards. A nerve that has been completely divided, seldom causes any inconvenience, except after amputation; yet it

must be in nearly the same situation, as to the granulating and cicatrization of the parts, as a nerve only partially divided. It is probable, that the inflammation which takes place in the substance of the nerve itself and its neurilema, and which is increased by pressure, may be the cause of the difference.

When a ligature happens to include a nerve, it is a long time before it comes away, and is frequently broken off close to the knot, leaving the noose behind, which causes a great deal of misery to the patient; and if the wound closes, never, perhaps, does come away. Dr. Hennen has given, in his Principles of Military Surgery, the case of Major-general Sir George Cooke, whom I saw several times, and who suffered very much from some nervous filaments, or branches of nerves, having been included in the ligatures on the blood-vessels. The pain was referred, when the ligatures were pulled upon, to the parts which they usually supplied, and once, when greater stress was laid upon them, to the brain; and other nerves arising from it were sympathetically affected; so that the pain was not only very acute in the head, but spasms of the muscles of the mouth and face were observed, with the other usual appearances dependent on intense pain. This suffering I have frequently seen in other instances, but the patients have described the pain as passing up the stump, and on to the head, with the greatest velocity; indeed, when nerves become morbidly sensible from disease or derangement, the passage of sensation from one part to another is often clearly described.

The changes which take place in the end of a nerve in a stump, are the reverse of those which occur in an artery, a vein, or even the bone itself. In these latter, a diminution of size takes place in several different ways, according to the proper texture of each; whilst in a nerve, the cut extremity swells, assumes a bulbous and oval form, becomes firmer in its structure, and permanently increased in size. When a ligature is applied on a nerve, this swelling of the end of it, which appears to me to be a natural occurrence, must prevent its ever slipping off, and the ligature can only come

away in consequence of the rotting of the silk or material of which it is composed. A large thick ligature will not readily break at the knot, a small one often does when much force is used. In the case related by Dr. Hennen, the ligatures were very large, and therefore were, as far as concerns the nerves included, favourable to the successful result. By leaving ligatures on nerves to the operations of nature, it is understood that they are left to decay; when the hold acquired by the noose being lost, they slip by the side of this bulbous extremity, which the nerve has acquired, and are withdrawn. I have known a ligature remain for nearly two years.

Wounds of nerves, causing very distressing symptoms, cannot always be so directly traced to the immediate seat of injury, or nerve affected ; and many alarming symptoms often arise, both locally and generally, which can only be attributed to the communication of derangement from one branch, or one trunk of a nerve, to another, and so on in continuation to the brain, from whence again other parts are affected through the medium of the nerves by which they are supplied*.

An officer of light cavalry received a wound from a musket-ball in the back part of the right thigh, near the trochanter major, which lodged, but which from its direction, as far as it is apparent, does not seem to have injured the great sciatic nerve. The wound healed in the usual time, but he found the affected limb much weaker than the other, and liable at times to suffer from intolerable pain, although it has never been deprived of sensation or motion. The pains are brought on by any exertion of walking. He cannot ride a horse that is wide in the back, or expose himself to any inclemency of

* Stumps are frequently subject to severe spasmodic affections, which extend towards the trunk in the course of the nerves, and are often productive of great alarm. I know one gentleman, who suffers very frequently from them, and as I conceive from two causes, exposure to cold, or derangement of the digestive organs; and he obtains relief from the use of purgatives, and the application of leeches and warm fomentations to the part, followed by the use of stimulants and narcotics.

the weather, without suffering materially. He is frequently very lame, and the pain is then felt principally in the sole of the foot and the outside of the leg, in the direction of the fibular nerve. There is also one spot on the outside of the thigh which has no sensation. Cramps, as he terms them, are frequently attacking him both by day and night, especially on any change of weather, or any personal irregularity; and if in bed, he is obliged to jump out, and put his foot on a cold stone, which affords him momentary relief.

An officer, who has retired from the service on his full pay and pension as Lieutenant, was wounded by a musket-ball, which entered above and behind the great trochanter, but does not appear to have materially injured the great sciatic nerve, although it has lodged in the pelvis. Sensation and the power of motion have not been materally affected in the lower extremities, although the right leg is altogether weaker than the other, rendering him incapable of taking any smart exercise, which is also prevented by the occurrence of pain, which becomes more severe on any change of weather. This gentleman not only suffers from pain in the sole of the foot and the side of the leg, but experiences very frequently such violent spasms in the whole leg and thigh, as to roar out in agony: and when the muscles are spasmodically affected, the contraction of them and the starting of the limb may be seen at some yards distance, accompanied by a corresponding motion of the muscles of the face. The bladder seems in this gentleman to have lost its power of expelling the urine, which requires, he says, to be drawn off with a catheter morning and evening, and when neglected he is subject to great pain in his abdomen, which comes on and occasionally continues even when this operation has been duly attended to. In other respects he is in tolerable health, although frequently obliged to sit up a great part of the night. The application of a tourniquet high up on the thigh generally affords some relief.

An officer of rank was wounded in 1812 on the inside of the left great toe by a musket-ball, which, from the ap-

pearance of the slit made by it, was supposed not to have entered. It was discovered, however, some days after, flattened and lying between this and the next toe, from whence it was cut out. Symptoms of inflammation, followed by great irritability, ensued, and numerous spasmodic affections rendered an attack of locked jaw very probable. Fortunately the spasms, although extending from the foot to the head, were more general, and this dreadful malady did not supervene, as was daily expected. This officer came to England, the wound healed, and the spasms, although general on the whole of the affected side, gradually subsided, and he was able to return to his duties. The toe continued extremely tender, rendering him incapable of taking much walking exercise; he suffered from occasional attacks of nervous indisposition, his powers of digestion became a little impaired, but upon the whole he continued in a tolerably healthy state until after the peace succeeding the battle of Waterloo, when the army was cantoned in France. At this period the spasms were more frequent and troublesome; the toe, and particularly that part of the foot on which he trod, became so tender, as to induce him to take means to prevent the pressure, but with little avail: the whole limb was slightly diminished in size. At this period I saw him, in consequence of a sudden increase of the spasmodic affection in the muscles of the back of the neck, mouth, and throat, accompanied by a sense of tightness, constriction, and drawing of the head, which seemed to him like the commencement of locked jaw, and the immediate forerunner of some mischief within the head. This paroxysm subsided, and was followed by others; but as his mind was relived from the fear of locked jaw or palsy, he became more at ease. I found that his digestive organs were much impaired, and that the general nervous distress frequently followed, sometimes preceded, and sooner or later was always accompanied by great uneasiness of stomach. Attention was paid to the digestive organs in an especial manner, but his relief from nervous irritation has not been commen-

surate with our expectation. An attack was often distinctly traced to exposing the foot to cold, or to pressure, and as frequently to apparent derangement of stomach, although no one could be more regular and attentive in regard to his food. From 1817 the complaint subsided, and he became more accustomed to it, but he received no benefit from any particular medicine, or mode of treatment, although various methods were tried, under the direction of Dr. Baillie and others. It was proposed to divide the nerve in the toe supposed to be injured; but Mr. Cline objected to that, as well as myself, and the patient is too well aware of the danger to suffer the experiment to be made. He is now much better, but cannot bear pressure on the foot; suffers from indigestion, although he takes every possible precaution to avoid it; and occasionally feels what he terms all the nerves from his toe to his head; but in other respects he appears in perfect health. In this sketch of his case I have only wished to draw attention to the great extent of the nervous system affected, and to the sympathy between it and the digestive organs.

In cases where the spine has been seriously injured, paralysis of the parts below the injury has followed in the usual manner, with the total deprivation of the function of the testis, and of the desire for sexual intercourse. Where the injury to the spinal marrow has not been so well marked, the powers of motion and sensation are sometimes only impaired. In one particular case of this kind, where the injury was high up in the dorsal vertebræ, and from a buck shot, the patient, although he can walk, declares he has lost all desire and capability for sexual intercourse, on which account he obtains a pension. In another instance the gentleman thinks the deterioration is considerable, but it is difficult on this point to get at the truth.

Spontaneous affections of nerves are by no means uncommon, and as far as I have been able to observe, resemble in their symptoms, according to the nerve affected, those occurring from an injury. Tic douloureux affords the best in-

stance of the branches of several nerves becoming affected by the same disease from communication, in like manner as the arteries of a part enlarge, although furnished by different trunks, when disease is fairly established among them; and this sympathy by continuity deserves particular attention, and in the treatment of wounded nerves may have a decided influence on the practice to be adopted, inasmuch as it is useless to divide one ramification of a nerve, where several branches of the same, or different ones, are affected.

Diseases of nerves of other parts of the body have the same symptoms as when they have sustained an injury. I have seen and know of several cases of affection of the great sciatic nerve, the pain of which was referred to the fibular nerve, and the sole of the foot. In one, the patient always traced with his finger the course of the fibular nerve, and then complained of the sole of the foot. When the spasms were severe, he could trace the great sciatic nerve; and pressure in the course of the nerve, where it passes out of the pelvis, always gave him great uneasiness. I conceived, according to the opinion of Professor Chaussier, that it in all probability depended on some low inflammation of the investing membrane of the nerve, probably at or about this part, causing a deposition of serum within it, which pressed upon, or otherwise irritated the nerve itself. Whilst I was deciding in my own mind, whereabouts, after cupping on the loins, I would apply the moxa, a severe attack of erysipelas came on the hip and thigh affected, and cured my patient.

In similar cases, or even in some which have been more severe, the moxa, blisters, and other stimulants have effected a cure, even when applied to the part to which the pain is referred. Richerand* supports the opinion of Cotunnus, and recommends a blister or the moxa to be applied immediately over and below the head of the fibula, where the nerve passes out in a very exposed situation; and he relates several

* Richerand, Nosographie Chirurgicale, 4th edition, tom. ii.

cases in which he obtained either complete or partial success by these means, attending at the same time to the state of the primæ viæ. On the failure of them, he recommends the application of the actual cautery on the pained part, and gives an instance of its efficacy in an old and very obstinate case, in which the patient had suffered more or less for upwards of thirteen years. This is analogous to the relief sometimes obtained from the application of a blister to the inside of the thigh, a little way above the knee, in a case of diseased hip-joint, when the pain is referred to that part.

Among the various internal remedies given for these complaints, arsenic has been much praised, but I have not had sufficient opportunities of verifying its good qualities in my own practice. In one well-marked case with which I am acquainted, it failed, whilst local pressure and irritation have been of essential service.

Mr. Pearson, in his very valuable paper entitled, Case of a nervous Affection, published in the eighth volume, page 252, of the Medical and Chirurgical Transactions, has many observations bearing strongly on the subject. The paper is too long to transcribe, but I have selected the concluding observations, as deserving particular attention.

" When a punctured wound is inflicted on one of the toes or a finger, by a small and sharp instrument, as a needle, or the fine point of a pair of scissors, a filament of a nerve is sometimes injured. The minute wound commonly heals immediately: but the muscles of the limb frequently become subject to spasmodic affections, during many months after the infliction of the injury; and the skin, with the subjacent parts, indicate a preternatural sensibility when pressed upon. In one of these cases, where the arm and hand of a young lady had become nearly useless, and the symptoms had been combated by all the usual remedies, in vain, during twelve months, the patient was cured by the application of a liniment, which excited a considerable tumefaction of the whole arm, with a vesicular eruption.

" It was necessary, in this case, to produce the cutaneous disease three times, at intervals of about a week, and it never extended beyond the upper extremity.

" In some cases, likewise, of painful contractions of the large joints, which were unaccompanied by inflammatory symptoms, or any remarkable change in the structure of the parts, a similar mode of treatment has been attended with complete success, after the common methods had been employed, during many months, without the least advantage. I think myself warranted to insist on the cutaneous excitement, with its concomitant appearances of tumefaction, and of an eruption more or less extensive, as circumstances essential to the obtaining of a cure in these peculiar affections of a nerve. It is proper to mention in this place, that there exists a very striking difference in the susceptibility manifested by the skin of persons suffering from these complaints. In some patients it is so irritable, that the concurring symptoms produced by the rubefacient appear in the course of two or three days; whereas ten days or a fortnight may elapse before any heat, redness, or tumefaction shall be seen in others; and, in a few instances, no sensible change on the surface of the skin, nor any beneficial alteration, has occurred from a long-continued application of the liniment, composed of two ounces and a half of the oleum olivæ, one ounce and a half of the oleum terebinthinæ, and one drachm of the acidum sulphuricum."

He further adds, " This mode of treatment is not applicable to that diseased condition of the nerves, in which a conspicuous morbid alteration is discernible in their structure, where little tumours, resembling noduli, are found in some of the larger ramifications of these organs of sense, connected with pain, lameness, muscular spasms, and sometimes with atrophy of the disordered limb. The existence of tumours thus situated, has been by noticed by different writers*; but I

* Vide Medical Facts and Obs. 6th volume. See also Portal, Anat. Medicale; the Edinburgh Medical and Physical Journal.

Mr. Crampton, of Dublin, has been so good as to inform me, that

am not aware that a satisfactory account has been presented to the world, of the differences which subsist in these productions, and of the rise, progress, and ultimate change of structure, which occurs in nerves when infested by such diseases.

"I am not authorised by experience to offer any information on the effect of this mode of treatment in cases of the tic douloureux. When nerves proceeding immediately from the cerebrum are the subjects of this painful disease, temporary relief is often conferred, and sometimes permanent benefit has been obtained by dividing the nerve whence their suffering seemed to be derived; but it must be likewise acknowledged, that this operation has often failed of curing the disease. In an instance, where the painful affection was referred to one finger, the patient was relieved by the amputation of the part; but a similar disease soon attacked one of the fingers of the other hand. The nerves distributed to different parts of the face have also been successfully divided, until very little of the surface of the skin remained, which had not been subjected to the operation. I never saw any real benefit derived from the division of a branch of a nerve, in either the upper or lower extremities, unless in those cases when the agency of a mechanical cause, or some well-defined change of structure, existed. When no deviation from the natural condition of the part can be detected by the most able and accurate examination, and when parts at a distance from the immediate seat of the pain, sympathise on every accession of the paroxysm, there is ground for presuming, that the source of the malady resides in some other portion of the nervous system, and that the division of the nerve in the part whence the pain seems to originate may prove rather injurious than beneficial. This unfavourable issue of an unsuccessful operation is not an assumption founded on mere reasoning or analogy; cases have occurred, where the patient has not only been disappointed

the best account he has met with of the subcutaneous tubercle is to be found in Camper's Anatomical Description of the Upper Extremity. Folio.—G.

of relief, but the irritation has been transferred subsequently to the spinal marrow and the brain."

Mr. Abernethy, in the second volume of his Surgical Works, has made some observations on injuries of nerves, and notices some cases mentioned by Mr. Pott and Dr. Monro in their lectures, in which the patients suffered distracting pain, followed by convulsions, and he recommends the operation of dividing the nerve at the part injured, with the view of removing the disease. In the same volume, he relates the case of a lady, who suffered from pain, resembling tic douloureux, of the parts adjoining the inner edge of the nail of the ring finger of the left hand, which occurred at irregular intervals, and in general without any evident exciting cause. As the pain increased, the disorder seemed to extend up the arm. At the end of eleven years " the pain of the part was intolerable; and it extended all up the nerves of the arm; and this general pain was so constant during the night, as to deprive the patient of rest. The muscles of the back of the neck were occasionally affected with spasms. The integuments of the affected arm were much hotter than those of the opposite side, and sometimes the temperature was so increased as to cause a burning sensation in them." Under these circumstances, Mr. Abernethy removed about half an inch of the nerve going to the part affected, being the inner side of the ring finger, opposite the second joint. The painful affection of the nerves of the arm still continued, though considerably lessened in violence. This pain continued occasionally about four months, with varying degrees of severity; but the temperature of the skin was not hotter than that of the opposite side, as it had been before the operation. At the end of nine months, the general pains in the nerves had become very trivial, but sensation at the end of the finger gradually returned, nearly to its natural state. The lady died, four years after, of disorder of the digestive organs; and Mr. Abernethy adds, " Indeed, from what I have since seen of cases of tic douloureux, I am induced to believe that this disorder is as much constitu-

tional as either gout or rheumatism." An observation, which, if it be applied to the case to which it is appended, must lead to the inference, that he would not, at a later period, have performed the operation.

Previously to the reading of Mr. Cruikshank's paper on the Reproduction of Nerves, in June 1776, to the Royal Society, which was published in the Philosophical Transactions for 1795, the possibility of the reproduction of the part of a nerve which had been cut out seems to have been unknown to the anatomists and physiologists of this, and, I believe, other countries. His experiments prove, that, in animals, this reproduction is very readily accomplished; and his paper deserves, I conceive, greater attention than has been paid to it. He found he could divide the par vagum and great intercostal, or sympathetic, of one side, in the neck, in a dog, with little or no inconvenience to the animal. Ten days after he divided both nerves on the other side, and the animal lived seven days. On dissection, he found the nerves on each side united by a new-formed substance, that, however, uniting the nerves last divided, being more bloody than the other. When he divided the nerves on both sides at the same time, the animal only lived twenty-eight hours, and in great distress, breathing with excessive difficulty. He repeated the former experiments of dividing the nerves on both sides, but removed a smaller portion, and performed the second operation three weks after the first. This animal lived, and he concluded, that, during this time, the nerve first divided (and of which a portion had been removed) was regenerated, and rendered capable of carrying on its usual functions.

Dr. Haighton read a paper to the Royal Society, in 1795, which is published in the Philosophical Transactions for that year, confirming the experiments of Mr. Cruikshank. He also went one step further, by proving that the regenerated part did really do the office of the original portion which had been removed. He divided the nerves of one side, and after an interval of six weeks, those of the other; from which

experiments the dog perfectly recovered. Nineteen months afterwards, he divided the nerves on both sides in succession, below the part where he had formerly cut out a portion of each, and the animal died on the second day, having been, in the whole of that period, in the greatest distress. If the nerve had not been regenerated, the last division could not have had the effect of destroying the animal.

Since this period, many experiments have been made on the regeneration of nerves; and, although it is admitted that the portion regenerated is capable of transmitting the nervous influence, it is still not supposed to be formed of real medullary matter; and there appears to be no doubt of its being, to a certain extent, of a different structure. Professor Meyer (Bibliothéque Germanique, vol. vii) asserts, that the reproduction is more readily effected in some nerves than in others, that it is more rapid in the tibial than in the ulnar, and least of all in the sciatic.

These facts prove, that, in *animals*, a portion of a nerve may be regenerated in a short time; that is, of the par vagum and great sympathetic in three weeks, and often in a less period; and rendered capable of performing in a satisfactory manner the usual offices of the original part of the nerve. It must be observed, however, th t these experiments have been made on animals; that there are no instances on record, with which I am acquainted, where a portion of any nerve in the human body has been regenerated in the same time, or to the same extent in any indefinite period of time; whilst the cases and facts I have adduced prove, that the reunion or regeneration of a nerve is a very difficult process in the human body, requiring years instead of weeks for its accomplishment, and in many instances never being effected. The conclusion to be drawn from this is, that there is an essential difference in the powers of reproduction in nerves, between the lower animals and man; and that experiments made on the former, to elucidate other circumstances attending the nervous influence in man, ought to be received with considerable caution.

From the facts which have been related, some strong practical conclusions may, I think, be made, referring to the local or general nature of the injury or affection.

It is highly deserving of remark, that in the case of Henry Croft, in whose radial nerve a piece of ball was sticking, and causing constant irritation, very different and additional symptoms ensued from those I have described to follow a simple injury. The part injured could not bear to be TOUCHED, and a swelling was perceivable on it, being two distinct signs of disease continuing in the part, whilst the contraction of the muscles was at the same time greater. I am, therefore, after attentive consideration, disposed to connect the symptoms of spontaneous disease, or alteration of structure in a nerve, with those of accidental injury, in which an irritating cause is constantly present; and to separate from them those accidental injuries and spontaneous affections of nerves, in which the part affected suffers no further inconvenience than that which it sustained from the actual infliction of the injury, or derangement of function. It appears to me to be of consequence to do this, with relation to the practical inference to be drawn, and in order to enable us to decide whether an operation should be performed, or otherwise; and I am induced to conclude, from the observations I have been able to make, that two different operations may be required in the first species of injury or disease, whilst sufficient relief may be in time obtained without any operation in the second.

The two operations are, the amputation of the limb, and the cutting out of that portion of the nerve which is affected. When a limb is supplied *principally* by one nerve, as the lower extremity is by the great sciatic, and the diseased part be the trunk of it, amputation is the only proper means of obtaining relief, provided the disease be incurable; because the removal of a portion of the nerve would be followed by the irrecoverable loss of sensation and motion in the part below, which would hang like a log of wood appended to the thigh, and greatly inconvenience the patient; whilst amputa-

tion would render him useful to himself and to society. It should also be recollected, that when disease has taken place spontaneously in a nerve, it is not possible to say how far it may have gone, and too small a portion may be removed, or the operation fail from its having extended to the surrounding branches. I have seen a disease of the popliteal nerve, causing a tumour within its investing membrane, render amputation necessary ; I have known a foreign substance irritating it to diseased action, require the same mode of relief; and I believe, that, consistently with the true principles of surgery, no other operation in such cases should be attempted. It is very different where there are several nerves going to a limb, or separating from the plexus with which they communicate, high up, or near their origin. In the upper extremity five nerves*, going to the arm, separate from the axillary plexus, it may be fairly said in the axilla ; and each may be divided, or a portion of it removed, at or near that part, if a necessity should arise for it. Lower down there can be little or no difficulty in removing a portion of any of them ; and this operation should be done, instead of that of amputation. In the case of Henry Croft, Dr. Denmark proposed it to the patient, and I think it might have succeeded, and therefore suggest, that in all similar cases, whether of spontaneous disease or of accidental injury, it should be done and found to fail, previously to amputation being recommended. If it succeed, a part of the extremity only will be deprived of sensation and motion ; and although I do not believe the portion removed will be regenerated, still a certain degree of sensation and motion may be recovered, by means of the communicating nerves extending their influence beyond their usual sphere of operations. I have shown, in three different cases, that an injury of a communicating nerve is capable of affecting a part to which another nerve is

* Seven nerves are given off by the axillary plexus; but I have not thought it necessary to notice them, or any communicating nerves from the chest.

directly distributed, and apparently for the endowment of it with sensation and motion. It is fair then to conclude, that the converse may take place, and sensation and the power of motion be partially, if not effectively restored, by the same influence exerted in a different manner.

Mr. Abernethy's case tends to prove this: the fatal cases which have been noticed, as occurring after operation, confirm it; and I am much deceived if the return of sensibility was not, in several cases of my own, owing to this communication of the different branches of the nervous system.

I have several other cases illustrative of these different facts, which it would be of no advantage to relate. They are, it will be perceived, in many instances, analogous in their results to the injuries which occur sometimes in bleeding from the arm, and it becomes a question whether the practice should be similar or not. When a branch of the internal or external cutaneous nerve is wounded in bleeding, the pain is said to be very acute at the moment of operation, and is soon followed by inflammation of the part and of the whole arm; the fingers become bent and clenched in the hand; the wrist bent forwards on the arm; the pains and spasms are augmented during certain paroxysms; and at last the muscles of the upper arm, neck, and face, are affected, and the patient suffers even from general convulsions. The disease either wears the patient out, is relieved or increased by operation, or gradually but slowly subsides under proper treatment. There is a peculiarity in these cases, when compared with several which I have related, which deserves attention; it is, that, considering the size of the nerve injured, and the function we suppose it has to fulfil, a much greater degree of contraction, spasm, and irritation, is produced in the arm; that more constitutional derangement follows, and a more general affection of the nervous system is induced, than usually takes place after a wound of either or the whole of the three larger nerves supplying, as may be reasonably supposed, more important parts. These differ-

ences between the two injuries may arise, I will venture to suppose, in consequence of the patient being in a bad state of health, in the one case, *viz.* of injury from bleeding; whilst, in the other, he is generally in a state of sound health at the moment of injury.

I am quite aware of the great similarity which exists between locked jaw and those spasmodic affections dependent on injuries of nerves; yet there is something very distinct in the affections, which I cannot explain, and therefore shall confine my present observation to the remark, that, if my opinion were required as to the probable occurrence of locked jaw in two cases, in one of which a nerve was certainly injured, and in the other there was reason to believe the nerves were no further affected than in a common injury, I should unhesitatingly declare, although the patient showed the same signs of approaching spasmodic affection in both, that the latter person was in greater immediate danger of locked jaw, and all its dreadful accompaniments, than the other; and this observation, although it may be incorrect, has not been lightly made.

As far as I have been able to obtain information, these affections after bleeding are by no means numerous; and, when compared with the number of persons who are bled, are extremely rare, and may, according to my ideas, be divided into two kinds; as dependent entirely on local injury, or on general derangement of health; which will account for the difference of success attending the treatment by operation. It is well known, that, in many instances, division of the nerve, or the removal of the integuments at the seat of injury, has effected an almost immediate cure; whilst in others it has failed, the spasms shortly returning, and only subsiding in the course of time. In a consultation on a case of this kind with which I am acquainted, the opinions of several eminent men were equal, for and against an operation. It appears, therefore, very desirable to arrive, if possible, at some conclusion on the subject; and, from such observations as I have been able to

make, I should say, that an operation is advisable for the division of the nerve ; or, as that may not be easily found, for the removal of a small portion of the integuments around the puncture, not including the vein, except it has been transfixed ; provided that the injury has been recent, and the pain is confined, or nearly confined, to the nerve supposed to be injured; if, on the contrary, other nerves have become affected, and the disease is constitutional, not local, or has originated spontaneously, I consider the operation to be inadmissible, and that both general and local treatment constitute the proper means of cure.

All the injuries I have noticed in these observations were treated consistently with these principles. In almost all, time has caused some, and, in many of them, so great an amelioration of the symptoms, that the complaint, although always a permanent defect, will yet be bearable, and preferable to the loss of the limb. In two cases only, that I am acquainted with, would the patients prefer the loss of the limb to the present evil. I did not recommend an operation in any of them, because I neither did, nor do believe, that the portion of nerve removed would, in man, be regenerated in an effective manner. If, however, the pain had become unbearable, and affecting the general health, I should not have hesitated to do it in preference to amputating the limb, except in the lower extremity. Mr. Earle, in the seventh volume of the Medical and Chirurgical Transactions, page 180, states the history of a successful case of removal of a portion of the ulnar nerve; to which I beg to refer, as containing many interesting facts.

The best means of mitigating the pain, independently of the application of heat and cold, which the patients soon choose for themselves, is by stimulants to the whole of the extremity, followed up by the application of a narcotic. I usually direct the part to be rubbed with the tinctura lyttæ, the oleum terebinthinæ, the liquor ammoniæ, &c. in the form of an embrocation, and of such strength as will cause on trial a good deal of irritation of the skin, short however of

producing any serious eruption, which, in cases of injury, I have not found beneficial, although I believe it to be so in cases of spontaneous disease. After the friction has been continued for a quarter or half an hour, the same part should be rubbed with an ointment composed of hog's lard and as much opium as it will conveniently bear, or the tinct. opii may be applied to the part on cloths frequently changed, or the extracts of belladonna, opium, or hyoscyamus smeared upon it; all of which seem to be very efficacious in allaying pain and procuring rest. The limb must be carefully protected from any great changes of temperature.

After the patient has recovered in a considerable degree, he will frequently experience a recurrence of the spasms, with apparently increased violence, which I have found to be generally caused by some personal imprudence, or sudden exposure to cold. Cupping on the loins and nape of the neck, according to the part affected, I have found exceedingly serviceable: in some of these cases acting like a charm, and with the aid of a purgative removing the additional inconvenience which had supervened. An officer received a shot through the knee-joint at the battle of Waterloo, and escaped without the loss of the limb; but suffers from great lameness, pain in the part, spasms in the thigh, and a want of sensation in certain places, indicating, also, the lesion of some nervous filaments. He applied to me a short time since in consequence of the nervous affection of the limb not only becoming more painful, but apparently inducing the same kind of uneasiness in the other thigh, in places corresponding to those of the affected side. I directed him to be cupped on the loins to the amount of sixteen ounces, to be purged smartly, put into the warm bath, and an opiate given at night. The next day he was perfectly well.

In addition to the practical conclusion to be deduced from these observations, there are, I apprehend, some points of importance with reference to the temperature of animals, or the evolution of caloric, which deserve attention, and which

do not appear to me to be easily reconciled, on the principles or hypotheses which are at present received on the subject, according to the experiments of Mr. Brodie*, Sir E. Home†, and Dr. Wilson Philip‡. All these gentlemen have been induced to believe that the evolution of caloric, or the temperature of warm-blooded animals, is greatly under the influence of the nervous system. Dr. Wilson Philip is, however, the most precise, and has reduced his opinions into the shape of a theory, which may be explained in the following manner. Vide pages 250 et seq. of his work, to which I beg leave to refer.

1. That the power both of the heart and vessels of circulation is independent of the brain and spinal marrow.

2. That the nervous influence is, however, capable of acting both as a stimulus and a sedative to the heart and vessels of circulation.

3. That the vessels of secretion only convey the fluid to be operated upon by the nervous influence, and that, like the vessels of circulation, they are independent of, but influenced by, the nervous system.

By which I understand that the vessels of a limb only convey the blood to be operated upon by the nervous influence, without themselves possessing any power of separating or recombining the constituent parts of that fluid.

4. That the function of secretion is destroyed by dividing the nerves of the secreting organs, and that it may be restored after it is thus destroyed by the galvanic influence.

5. The nerves to which Dr. Wilson Philip alludes are not the nerves of voluntary motion; but of the ganglian system, formed by the union of the par vagum, and the great

* Mr. Brodie, Phil. Trans. 1811, 1812.

† Sir E. Home, Phil. Trans. 1811, 1814.

‡ Dr. Wilson Philip's Experimental Inquiry into the Laws of the vital Functions, 2d edit. 1818, and his additional observations in the fifteenth and seventeenth numbers of the Journal of Science and the Arts.

intercostal, or sympathetic, which, as Ribes has shown, sends branches along with the great arterial trunks to the extreme parts, and as Dr. W. Philip supposes, pervading and making a constituent part of every portion of the body.

According to this opinion or hypothesis, an arm, in a paralytic state, is only deprived of the power of sensation and motion, in consequence of the nerves of volition being affected, whilst the circulation goes on in consequence of the independent power of the heart and vessels; secretion and the evolution of caloric being effected through the medium of the nerves of the ganglian system. This opinion seems to receive some support from the experiments of Mr. Earle, related in the seventh volume of the Medical and Chirurgical Transactions, in which, on the application of electricity, the temperature rose six degrees, and the parts in some degree obtained a temporary recovery of their sensibility. A paralytic limb, although generally colder than its corresponding sound extremity, is not always so, showing that the nervous influence, causing secretion, may be occasionally increased or diminished, that is, that the ganglian system may or may not be affected, by the same internal causes which produce disease in the nerves of volition.

This question is brought within a much narrower compass, if a limb, deprived of sensation and motion from the division of the nerves of volition, be substituted for a limb paralytic from internal causes; if we take, for example, the first case I have mentioned, that of the officer who was wounded at Salamanca, and whose arm is still paralytic, although thirteen years have elapsed. In this case the nerves of volition were certainly, I conceive, divided, and no influence whatever could be communicated to the hand, but through the medium of the ganglian system, which remained unimpaired; yet the evolution of caloric neither did, nor does, go on as it ought to do, proving, in my opinion, that the influence of this system is not alone sufficient for the perfect production of caloric.

In a case where the muscular or spinal nerve, and perhaps the external cutaneous nerve, appear to be the only ones injured, the general temperature of the whole limb is not affected; but only of the part to which these nerves are distributed. Now, if it be said that the shock arising from the injury (which is not perceptible to the patient) be the cause of this, it ought to have as much effect on the whole ganglian system of the limb as it has on the part to which the nerve is distributed; and as it certainly has not, I conceive I am justified in concluding, that the nerve of volition has something to do with the evolution of caloric, or, to speak more clearly, of that power inherent in the body, by which it is capable of resisting the application of heat and cold: a power which is always deficient in the part supplied, when the nerve of volition is injured. The experiments of Sir E. Home are not conclusive on this point, because it was the par vagum and sympathetic he divided, nerves which, according to Dr. W. Philip, form the ganglian system.

The nerves of volition seem also to have some influence on the vessels, or texture, of a part when in a state of inflammation, inasmuch as this process is generally defective in a paralytic limb, although, upon the whole, it shows the influence of the ganglian system in a more perfect manner than in the evolution of the animal temperature. The influence of the nerves of volition is also shown by the fact, that when a paroxysm of pain comes on in the part to which a nerve of that description is distributed, there is also a greater flow of blood to it. The experiments of Sir E. Home are here again not directly applicable, being on nerves of the ganglian system; neither do I agree with him entirely in his inference, on the influence of the nerves on the arteries, "that the ready supply of blood to a limb by the small anatomosing branches, when the principal arterial trunk is obliterated, depends upon the same cause;" for, if it did, there would be the same facility given for carrying

on, or re-establishing, the circulation in a case of divided artery as after an operation for aneurism, which is certainly not the fact.

If we suppose, according to Dr. Wilson Philip, that the evolution of caloric in the animal body depends on the ganglian system, would not some of the foregoing facts lead us to suppose, that part of the nerves of this system pass enclosed in the same investing membrane with the nerves of sensation and voluntary motion, and consequently suffer when those nerves are injured? This opinion, if it be admitted, cannot be regarded as at all interfering with the well-known fact, that the ganglian nerves do also accompany the great vessels.

Dr. W. Philip having read over the different cases alluded to, has been so good as to favour me with the following explanation, which he considers may, in some degree, clear up a considerable part of the difficulty, and which I therefore have great pleasure in transcribing.

" The reader will perceive, in perusing the account of the above cases, that the evolution of caloric was more affected by the injury done to the nerves, than the other ganglian functions were, although it was evident that all of them suffered. This is readily accounted for by a variety of observations, which prove, that slighter injuries of the ganglian system affect the evolution of caloric than its other functions. Thus many causes of irritation in the stomach and bowels greatly lessen the temperature of the extremities, and sometimes of the whole surface, even producing fits of shivering, which little influence the healing of wounds and other functions, for which the powers of this system are necessary. When, however, the irritation is long continued, we find it affecting all the functions of the ganglian system. Thus it is, that the healing of wounds and the state of other local diseases are so much affected by that of the secretions in the primæ viæ."

Thus far the first edition; since that was published, the discovery of the double origin of the fifth pair and of the thirty-one pairs of spinal nerves, by Mr. C. Bell, the anterior

root of each giving motion, the posterior one sensation to the part supplied by it, has caused our ideas on the subject of motion and sensation to be much more precise. It has not, however, been rendered subservient to the elucidation of any of the facts connected with the evolution of caloric in the animal body, although I believe it will materially assist in doing so; and I have been led to this supposition from the consideration of the following very curious case.

" A gentleman received a cut on the left side (but on the back part) of his head, which went through his skull, so as to leave the brain visible; and though the wound was nearly healed up in half a year, splinters of bone continued to come from it for nearly a twelvemonth.

At the same time with this cut he received another blow on the right side of the head, which laid the skull bare, but did not fracture it. After a temporary paralysis of all the limbs on the right side, the final result of these hurts was a loss of power and a disordered sensation in the second, third, and little finger of the right hand; and this affection has remained unaltered for thirteen years, except that it is sometimes aggravated by cold weather or by mental anxiety.

Seven years after this injury he fell from his horse, and again received violent contusions on his head at the back, and on the right side. The effects of concussion were strong, but there appeared no fracture. This brought on shortly after the usual effects of vomiting and stupor; but having under proper treatment in three weeks recovered from the illness consequent upon the bruises, he now found that he had suffered from this accident in a very peculiar way: the left half of his whole person was deprived of the power of resisting cold; and although he possessed the capability of motion as well as ever, there were considerable defects of sensation in various parts of that side. The symptoms are as follows.

There is a slight degree of numbness in the whole of the skin on that side, rendering inaccurate the perception of any object touched by the fingers, and also giving a degree of

insensibility to any external application; so that pungent liquids applied over *slight* cuts or scratches produce no pain, as they do on the healthy side, and even when a strong broad blister, placed on the back of the head, was kept open many days by repeated applications of cantharides, though under the half of its diameter on the right side of the exact middle of the head the pain excited was constant and severe, no perception of it was felt under the remaining half of the blister on the left. (This treatment was resorted to in hopes of relieving the symptoms of oppression by procuring a violent discharge.) In the mouth there was also a comparative insensibility on the left side to water or any other liquid so hot as to be painful to the right; and when the gums were under a violent ulceration, from a strong course of mercury, and on the right side felt a constant burning pain, those on the left were easy, unless chafed by any hard substance put into the mouth.

The sense of taste, though not totally destroyed, became also extremely imperfect on that side.

The sight or hearing were not materially affected.

The sense of smelling was totally destroyed in the right nostril, but remained perfect in the left, excepting to some particular odours.

The right side of the body is as perfect in resistance to cold as ever it was, and becomes, as in healthy persons in general, soon enured by custom to any change of climate, thus never requiring any change of clothing more than is commonly worn in this country. But the sensibility to cold on the left side is extreme and unalterable, and seems graduated with a painful correctness. In a still atmosphere abroad, or within doors at 68° of Fahrenheit's thermometer, that left side requires four coatings of stout flannel, when the right requires nothing but a light kerseymere coat and a dimity waistcoat. But at every $2\frac{1}{2}^{\circ}$ further depression of the thermometer the left side requires an additional covering of broad cloth or stout flannel to prevent a painful sense of cold. So that with the thermo-

meter down to frost, the weight of clothing necessary to preserve any sense of warmth becomes extremely burthensome. And this answers that purpose only in *still* air, because when exposed to a breeze, or moving against the air in quick riding or walking, it requires *one*, or sometimes *two* oilskin coverings, besides all these woollen wrappings, to prevent a sensation of piercing cold driving through the whole frame.

If these affections of cold are allowed to remain unremedied for any length of time, they produce great illness and extreme depression of spirits, and a weakening of mental energy. With this there are some varying partial affections; as a constant sense of numbness in the left foot and knee (besides the insensibility before alluded to as generated in the skin of the left side). The back of the left hand is one of the parts most intensely sensible of cold; but the fingers and thumb are but slightly so; though they will not endure the touch of cold water, and have sometimes been as bad as the back of the hand for a short period, at those times when the whole paralysis has seemed aggravated under those illnesses above mentioned as being caused by any continued severe suffering of the sense of cold; but these fingers have recovered their usual tone of feeling when that illness passed off: not so the hand.

Much illness, with a painful sense of oppression on the brain, is caused by even a very moderate continuance of reading or writing, by attentive study or earnest discourse, or in fact by any *rapid* or *continued* exertion of the mental powers: and the whole effect of the paralysis is always thereby considerably increased, and a great irritability is left upon the nerves.

After a violent course of mercury, intended (though unsuccessfully) to relieve the brain from oppression, and several years trial of low diet, very moderate use of liquids, and continued mild purgative medicine, under which the general health of the patient was kept much depressed, without any relief whatever from the sufferings described, it was disco-

vered, that a generous diet, with a moderate use of wine, not only lessened the extreme sensibility to cold, but even dispelled the headaches and oppressive sensations frequently felt in the head under the low diet and purgative system; and, singular as it may appear, bleeding, either with the lancet or cupping, has never appeared to relieve the paralysis, except in the earliest stage of the affection, when there was still some feverish action remaining from the violent bruises on the integuments of the head. Moderate horse exercise is found beneficial, as, like the generous diet (though in no wise lessening the paralysis), by improving general health and vigour, it gives a greater power to resist its oppressive effects. The warm bath has been tried, but with extreme distressing effect. The shower bath also, first tepid and then cool; this refreshed and invigorated the right side, but increased the paralysis in the left. Friction has been diligently used, first for many weeks with the pungent liquids, and afterwards simply, at various periods, but it increases the illness; as has done also sponging the skin with vinegar and water.

Every violent stimulus or quick incitement decidedly increases the affection.

These symptoms remain the same now, six years since the last accident.

With all this extreme sensibility to cold, the warmth of the left side to the touch seems to be equal to that of the right side, the thermometer standing at the same degree of temperature, rising from 76 to 81 when applied for half a minute. On brisk exercise in warm weather, the perspiration is more profuse than on the right side, even when there is not clothing enough to prevent a sharp sensation of cold. There appears to exist, as it were, a thin icy membrane coating the bones; there is not any shrinking of the parts or withering of the skin, although after exposure to a cool breeze, when inadequately clothed, a distressing sensation comes on, as though by some astringent process, the whole flesh, skin, and muscles

were all shrunk and withered up tight upon the bones, giving the sensation as if the half of the body was stiffly cased up in a hard dry parchment. The strength of the limbs was not much affected, after the first injury, or fall; but about half a year after a second attack of paralysis took place, apparently from a long, fatiguing mental exertion, since which the power of the affected side is diminished one half; and little use is made of that which remains, as any quick or vigorous action, although in no wise distressing to the limb, painfully strains the brain, as does most distressingly the action of bending the neck to look down upon any object. It was also from this secondary shock that the chest was so affected as to be liable to acute spasms from breathing cold air, or from humid respiration, as in talking quick or earnestly. In regard to the sense of smelling it should be observed, that possibly the defect in the right nostril may have been caused by the cut on the left side of the head, as until two years since, when you drew my attention to the subject, it had never occurred to me to try the nostrils separately; but it must be observed, that decidedly since the last accident to the right side of the head, there has been a curiously partial defect in the sense of smelling in the left nostril — the fragrance of many delicate flowers, as a primrose or cowslip, is as evident as ever, whilst that of the most powerful violet, or of some species of roses, is totally imperceptible, although the harsh smell of the bruised stalk strikes the sense strongly. This defect is unvarying.

The freezing sensation of cold increases rapidly and intensely on remaining in a quiescent state, so as to require, if I sit long still, a frequent augmentation of clothing, in a ratio rapidly increasing till the chill is so severe that no accumulation of clothes whatever will afford relief; for I then feel as if I were uselessly wrapping additional folds around a cylinder of ice covering the bones: the skin, however, is as warm apparently as on the opposite side. My only remedy at these times, if I wish to resume any sedentary occupation, is to start up and walk briskly, whereby I soon acquire warmth

enough to be able to dispense with a part of my extra clothing; and then I return to my books or letters, and begin the same troublesome process all over again, for the warmth excited by the exercise soon passes away. This strange sense of cold, so severe in a mere quiescent state, is greatly aggravated by earnest attention, such as listening to a sermon, to any long narration, or the attentive perusal of any interesting book. I must also notice the intense pain caused in my brain by being kept in suspense, as by listening to a person who stammers, or who is guessing the words of a letter he cannot make out."

In all cases of serious injury, or of the division of a nerve, there are, as consequences, loss of power and of motion, defective sensation to a greater or less extent; and the incapability of resisting either heat or cold, becomes apparent on a very moderate exposure to either. The loss of this capability has always appeared to me the most curious and inexplicable circumstance of the whole, whilst it has never been fairly accounted for by any of the hypotheses which have been brought forward on the subject. The idea, that it is referrible to the ganglian system, does not seem to be well founded; and if I might hazard a conjecture, I would say it was dependent on a power residing in the brain, above the origin of the fifth pair of nerves, and that a portion of nervous matter from this part was transmitted with every nerve of sensation, but not of motion. I cannot imagine an experiment to establish the fact, but I throw out the hint, that future experimenters may bear it in their recollection.

I believe the common temperature of the body to be maintained by the circulation of the blood; the evolution of latent heat to be dependent on the agency of this nervous matter.

M. Descot has lately published a work on this subject, containing the remarks and opinions of many of the principal surgeons of Paris. Whilst these confirm the observations which have been made on the injuries of nerves and their general consequences, they do not elucidate the doubtful point of the evolution of animal heat.

3. ON INJURIES OF THE EXTREMITIES

Requiring the Operation of Amputation.

Amputation, or the removal of a part or the whole of a member or extremity of the human body, is considered as the last resource in surgery, by which an evil can be remedied that is incurable by other means. This attempt to remove the disease by cutting off the affected part, has been known since the earliest ages of surgery; and the operation was formerly regarded with the greatest horror, as not only depriving the unfortunate sufferer of a limb, but most frequently of his life, in consequence of the length of time, and the almost insurmountable difficulties attending the cure. The operation was therefore seldom resorted to, was generally unsuccessful, and the patient was allowed to sink under his disease, from the very doubtful nature of the remedy proposed for his relief.

The general failure of the operation even within the last century, induced some surgeons to consider it unworthy the practice of surgery; and the general ill success attending it, from the inattention paid to the time of performing it, and the mode in which it was accomplished, induced others to deprecate its performance in almost every instance; and to trust to the powers of nature aided by art for the perfecting of a cure, even where the powers of both were obviously unequal to the task; founding their opinion on the general ill success of the operation when performed, and on the shock humanity receives from so dreadful an operation; but principally on the little good derived from the use of a remedy, whose success was worse than doubtful.

The improvements generally introduced into surgery have made amputation less formidable, and its success more certain; and the nature of the instruments used in modern warfare has caused it to become the most frequent operation of importance resulting from gun-shot wounds.

Although military surgeons have agreed in general, as to

the necessity of the operation in particular cases, yet they have disagreed very much, as to the precise time when it should be performed; some recommending it to be done as soon as possible after the receipt of the injury, others again deferring it until after a period of from three to six weeks, when the first inflammatory symptoms shall have abated, suppuration be duly established, the patient's constitution accustomed to disease, and, as they suppose, in a better state for undergoing an operation. This difference of opinion exists in some places at present, and both sides of the question have been supported by the highest authorities in the profession.

In England, Wiseman*, Surgeon to King Charles the Second, who had served during the war of the rebellion in the army, and also in the navy against the French, has the following passage in the fifth edition of his Work published in the year 1719: "In heat of fight, whether it be at sea or land, the chirurgeon ought to consider at the first dressing, what possibility there is of preserving the wounded member: and accordingly, if there be no hopes of saving it, to make his amputation at that instant whilst the patient is free of fever, &c." At page 175, he says, speaking of the operation being necessary, "and then it must be done in its proper time, that is to say, suddenly upon the receipt of the wound, before the patient's spirits be over-heated either with pain, fever, &c. Of the necessity of doing it speedily, I shall here give you one remarkable instance. A Scottish soldier was brought to me, out of the field of battle of Worcester, shot with a musket-bullet into the elbow-joint, which fractured not only the ends of the radius and ulna, but likewise that of the adjutorium; upon sight whereof, I called Will Clarke (now a chirurgeon at Bridgenorth) and other my servants (assistants) about me, to cut off the arm: and the while I endeavoured to encourage the soldier to endure it, in answer thereto he only cried, 'Give me drink, and I will die;' they did give him drink, and he made good his promise, and died soon after,

* See Wiseman's Chirurgical Treatises.

yet had no other wound than that. By which may be perceived the danger in delaying this work to the next day, when the foresaid accidents have kept them watching all night and totally debilitated their spirits, which happens not if it be done in heat of fight; therefore, while they are surprised, and as it were amazed with the accident, the limb is taken off much easier: and if it be the arm, some of them will scarce be kept in the hold while the ship is close engaged in fight. In the heat of fight I cut off a man's arm, and after he was laid down, the fight growing hotter, he ran up and helped to traverse a gun. And a Walloon earnestly begged me to cut off his shattered leg. Also others have begged me to dismember their shattered limbs at such a time, when the next day they have professed rather to die. But amongst us abroad in that service, it was counted a great shame to the chirurgeon, if that operation was left to be done the next day, when the symptoms were upon the patient, and he spent with watchings."

Le Dran, consulting surgeon to the French army, and a man of considerable experience in military surgery, in his work on gun-shot wounds, published about the year 1740, is decidedly of the same opinion. His ninth aphorism expressly states, " that when the amputation of a limb is indispensably necessary in the case of a gun-shot wound, it ought to be done without delay;" and at p. 209, of his second edition, he says, in speaking of wounds of joints, " that if there is a sure means of preventing the inflammatory symptoms, or bad consequences resulting from them, it is that of quickly removing the limb."

Ranby, surgeon to King George the Second in his campaigns in Flanders, confirmed the opinion and practice of Wiseman; and stated in fact the soundest principles in military surgery on the subject of amputation, although in a casual manner, in a small treatise on gun-shot wounds published in 1760, the object of which appears principally to be the recommendation of bleeding and bark. He says, p. 29, " If a wound be of such a desperate nature as to require amputation (which is

always the case when it happens in any principal joint), it would certainly be of consequence could the operation be performed on the spot, even on the field of battle: lest by deferring it an inflammation may come on, which one may very reasonably expect should obstruct a work, that ought rarely to be entered upon during the continuance of so calamitous a circumstance. The neglecting this critical juncture of taking off a limb, frequently reduces the patient to so low a state, and subjects the blood and juices to such an alteration, as must unavoidably render the subsequent operation, if not entirely unsuccessful, at least exceedingly dubious. And in wounds, even where no amputation is required, 'tis equally advisable not to defer the care necessary to be taken of them; lest by the parts being exposed to the air there might arise a series of very dangerous symptoms." At p. 84, he says, "A General of the Hanoverian forces, an officer of established merit of about seventy years of age, had his ancle, with the neighbouring parts, all terribly shattered by a cannon-bullet, and lay under the management of his own surgeon. My assistance was applied for the third evening after the accident. On examining the wound, I judged it a case that plainly required an immediate amputation. Accordingly, at the solicitations of the gentleman who attended him, I instantly cut off the leg: that night he rested tolerably well; and on the next dressing every thing seemed to carry so good a face, that I began now, notwithstanding his advanced age, and the circumstances of the operation not being performed sooner, to indulge some hopes of a favourable issue in the affair." The case terminated unfavourably; but Ranby, in the first of these extracts, expressly declares, that "it would be of consequence if the operation could be performed on the spot;" and in the second he states "the circumstance of the operation not having been performed until the evening of the third day, as a disadvantage."

This great distinction of the British surgeons as to time, was unknown, or little attended to, by many surgeons abroad; for Bilguer, the Surgeon-general to the Prussian army, in a

treatise published in the year 1762, against amputation in general, appears not only ignorant of it, but relates the case of Count Meerfeldt's suffering amputation on the field of battle as something extraordinary: a proof that he was not an impartial judge, in declaiming in the manner he has done against amputation, as an operation that could seldom succeed, when in fact he had never given it a fair trial. He carries his opinion so far, as to deny even the necessity of amputation where the limb has been torn off by a cannon-shot, and the parts hanging contused and lacerated about a shattered bone; showing, that the prejudice he had entertained against amputation had prevented his acquiring any practical knowledge on the subject; for, if human nature was the same sixty years ago as it is now, he must have found on trial, that a clean wound was much less likely to cause the death of the patient, than the dead parts, and shattered end of the bone: the separation of which must be a work of much time, accompanied by considerable pain, and attended by all the ill consequences that in those days followed amputation. At p. 40, Sect. XX. he clearly proves he did not know the point of practice established by Wiseman, as he says, "Those who follow this method, amputate within a few days of the accident, while the patient is vigorous, and without waiting for the event of any other kind of treatment: for, if the patient be weak, old, or very ill, even with the consequences of the wound, they do not venture upon the operation."

This was not however the practice of the English surgeons, Wiseman and Ranby, or of Le Dran, who expressly declare, the operation should be performed on the first day, and not within a few days of the accident; and this, with other statements, induces me to believe, that he had never fairly tried the practice, and was therefore unqualified to decide against its efficacy.

In consequence of this opinion, he suffered no amputations to be performed in the Prussian army, and gives the following statement of his success: "I had at one time during the war

in a military hospital 6618 wounded patients, who were all treated according to my direction, and part of whom I attended myself. Of these, 5557 were perfectly cured; 195 were able to do duty in person, or to work at any trade; 213 remained incapable of any labour civil or military; and 653 died. The 195 and 213 invalids were of the number of those who had their bones broken and shattered, of those, in a word, whose wounds were called complicated and dangerous. At page 61, he supposes, "of the 653 that died, 408 only died from shattered bones, the remainder of fevers, fluxes, and other injuries." He then says, "This number 408, is equal to that of those who were cured without amputation, although their wounds had been of the same kind. If, after making these calculations, we compare them with the prodigious number of wounded men, who at the beginning of the war had their limbs taken off on account of dangerous wounds, of whom scarce one or two escaped with their lives, we may very safely conclude, that much the greater part of these 408 men, cured and sent to the invalids, would have died if amputation had been performed upon them, and this shocking artificial wound added to what they had already received. It would be trifling to pretend that amputation would have saved a great many of those who died, had it been timeously and properly performed."

These statements of Bilguer have been frequently noticed, as much applauded, and in some countries held up as doctrines to be followed. Those who write from theory alone see not the errors he made in his calculations. The loss in numbers appears small; but Bilguer states, it is from men actually in hospital, and acknowledges, that many whose thighs were torn off, &c. on the field of battle, died without any assistance. Military surgeons also know, that the loss of men is principally on the first four or five days prior to their being brought into hospital. His soldiers, then, who died in this period, are not included in his calculation, which, therefore, gives no just idea of the loss of the Prussian army, except in cases of broken limbs, and not even of them; for he excludes, as dead, those

cases of broken limbs which were lost on the field of battle for want of surgical aid. And in reference to modern surgery, what would have been the result of the 408 cases deceased, which he presumes would have been amputated without his interference? 300 would have lived, and been able to work at any trade; of his 213 incapable of any labour civil or military, 150 at least would have been capable of earning their subsistence in health and comfort, instead of dragging on a miserable existence.

Bilguer, therefore, on this subject, ought never to be quoted as any authority for modern times; and I am satisfied he was not even good authority for 1762; for there is no reason to think that he would have met with different results, than Wiseman, Ranby, or Le Dran, if he had followed the same mode of practice.

The French Academy of Surgery, zealous in every branch of surgical science, bestowed considerable attention on the treatment of gun-shot wounds; and endeavoured to decide the point of the proper time for operating, by making it the subject of their prize question for the year 1756. Of the memoirs transmitted to the society, two only were considered to contain the information demanded; those of M. Faure*, a military surgeon, and of M. Le Comte, a surgeon in practice at Arcueil, both determining in favour of delaying the operation in all cases in which it was practicable to do so, although it should be indispensably necessary from the first. The academy decided in favour of M. Faure, not because his memoir was the best, but because it was supported by experience, whilst M. Le Comte's was entirely theoretical. The academy, in coming to this decision, appeared to adopt the only fair mode of judging the question; and there can be no doubt, that the memoir of Faure, thus sanctioned, not only had great weight at the time, but that it also biassed the minds of many subsequent surgeons. The members of the academy who thus de-

* See Prix de l'Académie de Chirurgie, tom. viii, duodecimo, Paris.

cided in favour of Faure, were not however unprejudiced judges; many of them were teachers, and nearly all of them believers in doctrines, according to which it was impossible immediate amputation, or that performed shortly after the injury, could succeed; and when they found Faure relating ten cases of delayed amputation, all successful, which were expressly reserved for the experiment after the battle of Fontenoi, in 1745, whilst the advocates for the opposite practice could only produce four out of nine, they considered the matter as being beyond dispute.

M. Faure acknowledges what his successors in opinion have overlooked; that many wounds, requiring amputation, would destroy the patient before the proper period of performing it; but he passes over this objection (which in modern surgery is most important) by stating, that these persons must die, whether they were amputated or not; and concludes, they would only die the sooner for the operation. He allows, however, six kinds of wounds, and Le Comte seven, requiring amputation without delay. In these cases, which are of the worst kind of gun-shot wounds, they also acknowledge, that the danger of amputation is not equal to that which is likely to ensue, if the shattered limb be retained.

M. Boucher, having had Faure's observations communicated to him by the academy, replied to them in a very excellent memoir*, that well deserves the attention of the military surgeon, and points out, very distinctly, three proper periods for amputation.

First, The period between the receipt of the injury and the appearance of the inflammatory symptoms. For the usual consequences of gun-shot wounds, tension, swelling, throbbing, acute pain, fever, &c., do not take place at first, but follow, sooner or later, according to the extent and complication of the wound, and the nature of the constitution of the patient.

Second, When the inflammatory symptoms have com-

* Mémoires de l'Académie de Chirurgie, seconde partie, tome vi, duodecimo, Paris, 1753.

menced, and are more or less capable of disturbing the animal economy.

Third, When the violence of the inflammatory symptoms and symptomatic fever have abated; the period pointed out by Faure as advantageous for amputation.

In inquiring into the success attendant on amputations performed at these periods, he proves very correctly, that many limbs must be amputated on the field of battle to give the sufferer a chance of life; and that these operations were not always followed by the bad consequences usually attributed to them. He therefore considers Faure to have drawn his conclusions from the bad success, which he also acknowledges to attend amputation performed at the second period, and which he thinks Faure did not duly discriminate. In allowing him due credit for the success of his ten operations performed at the third period, he satisfactorily proves from his own experience, as well as that of others, and especially of M. Vandergracht, who had charge of a part of the wounded after the same battle of Fontenoi; that many must die in waiting for this third and favourable period, who would have had a fair chance of recovery, if amputation had been performed in the first. He concludes his memoir by upholding the aphorism of Le Dran, "that when amputation is necessary in a case of gunshot wound, it should be done as soon as possible after the receipt of the injury as the state of the patient will permit;" a doctrine that militated too much against the received theory of the day, and which was therefore rejected, although supported by experience.

It is but justice to the Germans to state, that Schmucker, who followed Bilguer, as Surgeon-general to the Prussian armies, published, in 1776, an essay on this subject, in which he opposed, in a very successful manner, the opinions of Bilguer, and expressly declares himself an advocate for immediate operation, in all cases in which amputation from the first appears to be necessary; and insists, in a particular manner, on

the greatly increased danger which he had observed to arise from operations performed during the second period.

It would appear almost impossible that there should be so much difference of opinion upon a subject that might, and could only be decided by actual experiment; it is a proof, however, of the readiness with which the mind may be biassed in favour of any thing, that it may have presupposed from reading and reflection; and how readily observation and experience are made subservient to our opinions. No one can suppose, that any of these authors wrote what he did not himself believe to be true; and if part of them and their advocates did adopt the sentiments of others, without much actual experience of the subject upon which they treated; still many of them must have had sufficient opportunites of ascertaining the fact, if they had attended properly to it. But prejudiced for the most part in favour of delayed amputation, from its coinciding with their opinions, they would not attend to those of its opposers; or, when they did give them a trial, it was not with due attention to their injunctions as to the precise period of operating. The adversaries of delayed amputation could not support their facts by the received hypotheses of the schools; and as the bare assertion of facts is even at this period insufficient to overturn a favourite opinion, it is not surprising that it should then have been disregarded.

A great and important alteration in the method of treating amputations, was introduced to public notice in the year 1782, by Mr. Alanson *, that of procuring union of the parts divided without waiting for suppuration, by bringing them into contact immediately after the operation; by which, and other improvements of that period, the mortality after amputation has been considerably diminished, when compared with the practice of the preceding forty years. It was reasonable to suppose these improvements would have had some effect on the operation, as required in military surgery; and there can be

* See Alanson on Amputation.

no doubt that the same good effects would have followed, if they had been duly practised, as at the present day. Authorities were however against the performance of the operation, except at a late period. When it was performed earlier, the due time of doing it was not sufficiently attended to, many of course died who had submitted to it, and when a soldier did survive, it was considered more as a piece of good fortune than of good practice. Military surgeons neglected, or did not make themselves acquainted with the opinions of each other, and feared to deviate from the road marked out for them by their teachers.

In the year 1792, the Baron Percy, late Inspector-general of the hospitals of the French army, published his Manuel de Chirurgien d'Armée, a book for many years received, and which indeed is still received, as a standard work in France. After relating several cases of severe gunshot wounds, and giving directions for their treatment, he says, at page 168, "But I stop here, to avoid entering into discussions foreign to my subject, and particularly to avoid that of the necessity of immediate or delayed amputation, in cases of wounds of the joints, which has so long occupied the attention, and divided the opinions of practitioners."

In his second part he gives the opinions of La Martinière, Morand, Louis, Andouillé, Sabatier, and Dessault, as well as his own, in an uninterrupted discourse, the tendency of which is against amputation on the field of battle, where it can be avoided; giving the preference to the delayed operation, even in such cases as clearly require amputation at first. He declares however that there are cases demanding amputation on the field; and in his extemporaneous answers to a series of questions proposed by the Commission of Health in 1794, he indicates several, and recommends that the operation should be done immediately; but so far from being understood to recommend that it should be performed in every case where it is requisite, yet in which it is possible to temporize or delay, he has left the impression on the minds of the French surgeons

that it ought to be delayed; and I have accordingly been referred to his work, by a French surgeon in chief of an army, as containing opinions worthy of consideration, in opposition to those of the Baron Larrey, on the advantages of immediate amputation; a fact which is conclusive as to the opinion entertained in France of the general tendency of M. Percy's works on this subject.

The year after, in 1793, although the work was not published until 1794, Mr. Hunter, Surgeon-general to the British army, indisputably the first surgeon of the age in which he lived, and whose great talents would have left nothing to be written on gun-shot wounds, if he had had the same opportunities of acquiring knowledge on this subject, as he had on others; and who has erred on a point which could only be decided by personal experience, says*, page 561, "Amputation of an extremity is almost the only operation that can, and is performed, immediately on receiving the injury.

"As these injuries in the soldier are generally received at a distance from all care, excepting what may be called chirurgical, it is proper we should consider how far the one should be practised without the other. In general, surgeons have not endeavoured to delay it till the patient has been housed, and put in the way of a cure; and therefore, it has been a common practice to amputate on the field of battle: nothing can be more improper than this practice for the following reasons: — In such a situation it is almost impossible for a surgeon, in many instances, to make himself sufficiently master of the case, so as to perform so capital an operation with propriety; and it admits of dispute, whether at any time, and in any place, amputation should be performed before the first inflammation is over: when a case is so violent as not to admit of a cure in any situation, it is a chance if the patient will be able to bear the consequent inflammation; therefore, in such a case, it might appear at

* Hunter on the Blood, Inflammation, and Gunshot Wounds.

first sight, that the best practice would be to amputate at the very first; but if the patient is not able to support the inflammation arising from the accident, it is more than probable he would not be able to support the amputation and its consequences. On the other hand, if the case is such as will admit of being brought through the first inflammation, although not curable, we should certainly allow of it; for we may be assured that the patient will be better able to bear the second.

"If the chances are so even, where common circumstances in life favour the amputation, how must it be where they do not? How must it be with a man whose mind is in the height of agitation, arising from fatigue, fear, distress, &c.? These circumstances must add greatly to the consequent mischief, and cast the balance much in favour of forbearance.

"If it should be said, that, agreeably to my argument the same circumstances of agitation will render the accident itself more dangerous; I answer, that the amputation is a violence superadded to the injury, therefore heightens the danger, and when the injury alone proves fatal, it is by slower means.

"In the first case, it is only inflammation; in the second, it is inflammation, loss of substance, and most probably loss of more blood, as it is to be supposed that a good deal has been lost from the accident, not to mention the awkward manner in which it must be done.

"The only thing that can be said in favour of amputation on the field of battle is, that the patient may be moved with more ease without a limb than with a shattered one: however, experience is the best guide; and I believe it is universally allowed by those whom we are to esteem the best judges, those who have had opportunity of making comparative observations, with men who have been wounded in the same battle; some where amputation had been performed immediately, and others where it had been left till all circum-

stances favoured the operation; it has been found that few did well who had their limbs cut off on the field of battle; while a much greater proportion have done well, in similar cases, who were allowed to go on till the first inflammation was over, and underwent amputation afterwards.

"There will be exceptions to the above observations, which must be in a great measure left to the discretion of the surgeon; but a few of these objections may be mentioned, so as to give a general idea of what is meant.

"First; it is of less consequence, whichsoever way it is treated, if the part to be amputated is an upper extremity; but it may be observed, that there will be little occasion in general to amputate an upper extremity upon the field, because there will be less danger in moving such a patient, than if the injury had happened to the lower.

"Secondly; if the parts are very much torn, so that the limb only hangs by a small connection, then the circumstance of the loss of so much substance to the constitution cannot be an objection, as it takes place from the accident; and indeed every thing that can possibly attend an amputation; therefore, in many cases, it may be more convenient to remove the whole. In many cases it may be necessary to perform the operation to get at blood-vessels, which may be bleeding too freely; for the searching after them may do more mischief than the operation."

M. Lombard, Professor in the Military Academy at Strasbourg, in his "Clinique Chirurgicale des Plaies faites par Armes à Feu," published in 1815, and written professedly from experience, has endeavoured to support the arguments of the older French authors in favour of delayed amputation by advancing a number of reasons why immediate amputation must necessarily be improper, according to the rules of surgery; but he brings few facts to support his opinion; and it is easy to collect from his work, that he had not given amputation within the first twenty-four hours a fair trial in his own practice; but has drawn his conclusions from the

operations performed at, or sent into, the sedentary hospitals of Mayence, Landau, and Strasbourg; and not from those performed by himself, in the hospitals accompanying the army. The cases of ill success following immediate amputation that he adduces, were not under his own care from the first, or performed by himself, but came to the hospitals in the rear, under a variety of circumstances that would militate against them. He allows, there are many cases which must be operated upon in the field of battle, but declares that when an operation, although indispensable, can be delayed until the secondary period for amputating, it ought to be delayed, to allow of the necessary preparation of the body. He illustrates the necessity of this preparation by declaring, that to perform a common bleeding with success (saignée de précaution) the patient should be fasting, that he should have been perfectly quiet for some hours, and that the body should be of a regular and equal temperature; to ensure all of which requisites he should be bled in bed in the morning in summer, and between eleven and twelve o'clock in the day in winter.

Mr. John Bell, in his work on Wounds in general, published in the year 1798, has recommended the performance of amputation, in some cases, as soon after the receipt of the injury as possible; but Mr. Bell's advice was not generally received, although it had some good effect, because every one knew, as far as regarded himself, that it did not proceed from experience; and in deprecating the practice of Bilguer, he omitted to support his own opinion by the rules and repeated counsels of the older military surgeons on the subject; which would have impressed the fact upon the minds of his readers, instead of leaving it a matter of mere opinion.

In France, the Baron Larrey, lately one of the Inspectors-general of the hospitals of the French army, in his "Campagnes et Mémoires de Chirurgie Militaire," a work which particularly deserves the attention of the military surgeon, has

endeavoured in various parts to prove the great advantages of immediate amputation, and to establish its superiority over that usually practised at a subsequent period; and he has, I believe, after much opposition, at last successfully established it in the French army. The authorities of the older writers, the vacillatory opinion of the Baron Percy against it, and the strenuous support of M. Lombard, &c. in favour of the delayed operation, have yet, however, retained it some advocates.

In Great Britain, military surgeons have not until lately given due publicity to their practice, and it is only through the medium of those authors who have taken the trouble to inquire into it, that the necessity, or propriety, of immediate amputation in gun-shot wounds that require such an operation, has been made known. It is not, therefore, surprising, that some lecturers on surgery should have continued to teach the necessity of delaying amputation in cases requiring that operation, long after the practice had been abandoned by military surgeons.

The writings of Mr. Hunter in England, and of Messrs. Percy and Lombard in France, guided the opinions of most succeeding teachers, on this subject, and often influenced the practice even of military surgeons, who relied more upon authorities than experience: they could not, however, entirely overcome the dictates of good sense when combined with actual observation; and we find, that at all periods some surgeons continued to amputate on the field of battle, without attending to the doctrines inculcated on the subject. During the American revolutionary war, many examples of the kind were met with. In the campaigns between the British and French armies, in the first part of the French revolutionary war in Flanders, operations on the field were by no means uncommon. In the expedition to the Helder, I am informed by Mr. Knight, late Inspector-general of hospitals, it was the regular practice to do so in all urgent cases. In Egypt, Dr. Pitcairn states, and Messrs. Nicolai and Morel

have assured me, they only regretted that opportunities for amputating on the spot were not, from the nature of the service, more frequent. The impression resulting from these services was, that immediate amputation was preferable to delay; and in America, in 1804, I did not hesitate, in three instances of accidental gun-shot wounds, to amputate directly after the receipt of the injury. The success attending these cases confirmed and established in my mind the propriety of immediate amputation; and the first action which took place in Portugal, on the heights of Roliça, in which the 29th regiment, to which I belonged, sustained the greatest loss, enabled me to prove it. I believe the first amputation performed in the Peninsular war was done by me, the second by the late Mr. Morel, of the Westminster Hospital, whom I have alluded to as serving in Egypt. It is but just to the surgeons of the regiments serving with General Spencer, who sailed from England nine months previously to the embarkation of the troops under Sir Arthur Wellesley, and joined him in Mondego Bay, to say, that all of them had made up their minds to operate without delay during our stay at Gibraltar, when the siege of Ceuta was supposed to be our destination. I am quite aware that at this period the same practice had been adopted in the navy, and when I published the first edition of this part of the work, it was not done with the intention of convincing any military surgeons of the propriety of a practice which was common to all of them; but with the view of relating what had been done, and of preventing the further dissemination of error by means of those who taught a practice they did not understand, and of which they had no competent means of judging from actual observation. I do not believe that in 1815 there was one naval or army surgeon in the British service, who would have delayed, until the second period, an amputation which was clearly indicated to be necessary, although there were a few in the French army who preferred operating after the first inflammatory symptoms had sub-

sided. This was not the case in private life: many of the principal surgeons in London and other places advocated the propriety of delay and the opinions of Mr. Hunter, and taught to rising surgeons doctrines which had been found wanting in practice, and which could not be too soon exploded.

During the course of the Peninsular war, the success of amputations performed on the field of battle became so notorious, even among the soldiery, that the anxiety expressed by them, to have these operations executed with as little delay as possible, has sometimes been prejudicial; for as much attention must be paid, in my opinion, to avoid operating too soon, as too late, and perhaps for a reason quite contrary to that usually received as legitimate for not operating, *viz.* that the sufferer may have time to recover from the shock of the injury, and approach as near as possible to a state of health; and the farther he is from this state, the greater the chance of a fatal termination.

If a soldier at the end of two, four, or six hours after the injury, has recovered from the general constitutional alarm occasioned by the blow, his pulse becomes regular and good, his stomach easy, he is less agitated, his countenance revives, and he begins to feel pain, stiffness, and uneasiness in the part: he will now undergo the operation with the greatest advantage; and if he bears it well, of which there will be but little doubt, he will recover in the proportion of nine cases out of ten in any operation on the upper extremity, or below the middle of the thigh, without any of the bad consequences usually mentioned by authors, as following such amputations.

If, on the contrary, the operation be performed before the constitution has recovered itself, to a certain degree, from the alarm it has sustained, the additional injury will most probably be more than he can bear, and he will gradually sink under it and die. At the storming of Ciudad Rodrigo I amputated a thigh in a convent close to the breach, within half an hour after the accident, at the anxious desire of the patient, the leg having been destroyed by the explosion of a shell.

There was not more than the usual loss of blood, or of delay in the performance of it; my patient did not however recover the shock of the operation, and at daylight I found him dead, without the bandage being stained with blood. At the battle of Salamanca I had two men brought to me during the action, labouring under great anxiety: one had his arm carried away close to the shoulder, and his breast considerably grazed by a cannon-shot; the other had the greatest part of the leg torn away close to the knee; this was about four in the afternoon. These men, amongst many others in the like situation, were particularly low, and the constitution seemed to sympathize more with the injury. They were laid in a dry ditch, without any covering, and a very small quantity of rum and water was given them during the night. At daylight, five in the morning, they were much recovered, the countenance was less ghastly, the pulse regular and good, the stomach not irritable, and, what is of essential importance when this delay has taken place, the wound was becoming stiff and painful. The disposition for inflammation was forming, and would of course have been very great, from the lacerated and incurable state of parts, if it had not been prevented by removing the whole of the seat of the injury, leaving only a clean incised wound, the greater part of which healed by the first intention, with little comparative fever or constitutional derangement. Instead, then, of inflicting an additional injury on the original one, and increasing the general symptoms of irritation in those persons, they were completely relieved, became calm, tranquil in mind as well as body, gradually recovered something more of their natural appearance, took some light nourishment, and slept. If these men had suffered amputation when first they came to me, I think their recovery would have been less certain; and I have, under such circumstances, seen more than one man die on the table.

The inflammation succeeding after amputations of this kind, is not in general more than is requisite for the necessary actions of adhesion and suppuration, and the attendant fever

is mild and easily retained with due bounds. It is frequently, indeed, under these circumstances, so mild, as not to affect materially the appetite of the patient, who is only restrained from eating by the strict injunctions of the surgeon. The recovery is perfect in most cases in a month, when the operation has been well performed; and innumerable evidences may be seen in England of these cases having been followed by no ill consequences.

All the operations of amputation of the upper extremity, and those below the middle of the thigh, generally follow this course. There are, however, in particular constitutions exceptions, in which there is much nervous irritation; but these deviations are more frequently to be met with when the operation is delayed to a later period.

When a thigh is destroyed by cannon-shot above or at its middle, the injury is very great, and the danger proportionate. The shock is frequently more than the constitution can bear, and the patient dies in a few minutes without much hæmorrhage. The loss of blood is sometimes considerable; and whenever this has occurred, it very much destroys the chance of success of the operation. The influence, however, of the injury on the nervous system is most to be dreaded; and this is so great, that many, indeed the greater part of this kind of injuries are generally fatal, without coming under the observation of the surgeon. An operation under these circumstances would, in my opinion, only hasten the dissolution of the patient.

A cannon-shot struck an officer of the 27th regiment in the middle of the upper half of the right thigh at the battle of Toulouse, went through the left thigh of a soldier at its middle, and through the thigh of the man behind him a little lower down. The officer was carried into a house a short distance from the place of the accident, and I saw him a few minutes afterwards; the soft parts were torn to the groin, the femur shattered to the trochanters, the femoral artery, vein, and anterior crural nerve fairly divided. He had lost more blood than is usual after a limb being torn away, but the hæmorrhage had

ceased. He was pale, ghastly, unable to move, showed great anxiety of countenance, the pulse small and quick, the skin clammy, his face bedewed with a cold sweat, he could articulate but with difficulty, and did not appear to suffer much pain. Here any operation would have been instant death. As the fire of the enemy was very smart around the house, I remained in it with him and some other wounded, with the hope of being able to rouse him sufficiently by cordials and stimulants to bear an operation. He at first tried to swallow a little wine, but the constitution could not recover itself, and in less than two hours he died; I found the two soldiers after some search the next morning, in a barn where they had been carried, and remained undiscovered during the night. Amputation by the circular incision was performed on these men about twenty-four hours after the injury by Staff-surgeon Lindsey; and both died; one shortly afterwards, the other the next day, whilst incautiously carried by mistake on a car into town. Another, under similar circumstances, operated upon by the same gentleman, recovered remarkably well; and a fourth, whose femur I amputated at the little trochanter by the flap operation, at the end of the fifth week, in a case of compound fracture, when suppuration and hectic fever were well established, died in about three hours, apparently from the shock of the operation, although it was performed in a very short space of time, and with little loss of blood, and that nearly all venous. This accident as frequently occurs in operations at the secondary period as on the field of battle, so that it appears to depend on a peculiarity of constitution not discoverable *à priori:* and if the patient surmount this trial, both in the primary or immediate operation, and the delayed or secondary operation, the chance of ultimate success bears no proportion in favour of the former.

Inflammation in the seat of injury comes on at an indeterminate period, varying in different people. When the injury is high in the thigh it commences sooner than in the leg or arm; and the symptomatic fever accompanying it is proportionably

severe. If, then, after an injury, where the alarm has been very great, and the powers of life considerably diminished, so as to have prevented an operation shortly after the accident, some little re-action should take place, the patient should become restless, the pulse quickened, the parts injured painful, the operation should be no longer delayed; for the removal of the diseased parts can only moderate this nervous commotion, and prevent delirium and death. From the peculiarity above noticed the operation may destroy the patient, but the injury would of itself be no less fatal, and the chance of success is therefore in favour of the operation; for I never saw a person in this state live long enough for suppuration to be established, much less to survive all the first accidents attending a wound of this nature.

If the operation be delayed beyond the first twenty-four hours in some persons, and in others thirty-six hours, pain, heat, tumefaction, and the other constituents of inflammation come on rapidly; attended by increased arterial action, severe nervous twitchings, thirst, heat of skin, general restlessness, delirium, and the patient is soon carried off, if the injury has been extensive. Many very severe wounds do not terminate so quickly, the symptoms exist in a less degree, and may be moderated by the antiphlogistic treatment until suppuration is established, and the primary high excitement reduced within the limits of hectic fever, depending upon the iritation of incurable parts.

In any period from the time inflammation has commenced in the seat of injury, and symptomatic fever is established, amputation is performed under very different circumstances than when it has been done prior to their supervention; the parts to be divided are no longer in a healthy state; they have taken on inflammatory action tending to suppuration, and will not unite by adhesive inflammation, as they would have done if they had been divided forty-eight hours sooner. The operation, instead of relieving the symptomatic fever, greatly increases it. It is now really a violence superadded to the in-

jury; and the patient dies, unless very active means are employed for his relief; and even under the most vigorous and attentive treatment it frequently proves fatal, although his life may be prolonged for some days.

All these operations have been unjustly called amputations on the field of battle; and when so much danger attends them under the improved mode of treatment of modern surgeons, it is not surprising they were generally fatal among the older ones, and were of course discredited. Military surgeons therefore endeavour to have all their operations performed within the first twenty-four, or at most forty-eight hours after the injury; and where due attention can be paid to medical aid, attendance, diet, &c. as is generally the case with officers, the result is surprising; and even with soldiers, labouring under all the disadvantages of a military life and temporary hospital accommodation, it is very satisfactory, when compared with the result of operations performed in the same hospitals, at a later period, when the accommodation is much better.

It is argued, by the advocates for delayed amputation, that soldiers are not in a state of rude health during a campaign; that they have been ill fed, badly clothed, have suffered much from fatigue, and that they are not in the same state as persons in civil life meeting with the same accident. This is far, however, from being the fact with reference to the British army in the Peninsula, which was composed of men in the prime of life, the greater part under thirty-five years of age, very many under twenty-five; they were always well fed, with an occasional exception; their appearance indicated high health, their diseases were frequently very inflammatory, and the use of the lancet, and the antiphlogistic regimen, were carried farther, and more successfully, than would be ventured upon in England. It can never be argued, that the principal part of the officers of the British army are not young men in the flower of their age; and from operations performed on them, I would from choice take my examples. The result is within

the reach of any surgeon in England. Let inquiries be made of any of the mutilated officers, to be seen in the streets; when they lost their limbs, in what state of health they were when they suffered amputation, and what inconvenience, in regard to their general health, they have since experienced? Let inquiries be made of the friends of those who died after amputation, at what period it was performed? and one instance will hardly be found in ten, of an unfortunate termination after operations performed on the field of battle.

The adversaries of immediate amputation, founding their opinions upon the soldier being in a state of rude health at the time of injury, and supposing that state inimical to disease, have not, it appears to me, sufficiently considered the very great alarm and shock given to the constitution, on the receipt of the injury; they have not sufficiently considered the loss of blood that takes place the moment a limb is destroyed by cannon-shot, or the loss of blood during the operation; they have not duly considered, that the reaction of the constitution, producing high inflammatory fever, can be more readily suppressed, and with more safety, in a healthy, than in an irritable constitution.

Others* have chosen to consider the soldier as frequently in a state of inebriety, or as having his stomach full of food of various kinds at the moment of injury, and have considered this state to preclude amputation; and it certainly is not a state that would be selected for it; but they have overlooked this circumstance, that if a soldier was drunk at the moment of the injury, the shock of the blow, the loss of blood, and a few hours delay, would remove all the effects of the liquor, except debility; and, as to the stomach, it will generally be emptied on the receipt of the injury; and if it be not, the cathartic usually given after the operation, and a strict abstinence from solid food, will obviate any mischief it might produce, although I declare I have never seen any; and it is to

* See Lombard, p. 85, Clinique Chirurgicale des Plaies faites par Armes à Feu.

be supposed that officers, whose cases are almost always successful, would be very liable to these inconveniences if they did occur. Upon the whole, I consider these objections to have arisen from theory, not practice, and therefore to be disregarded.

All these authors are obliged to allow that there are some cases which cannot be removed, and must be amputated on the spot; but if these unfortunate people survive the operation, they are called phenomena, accidental effects of nature, &c. What is more extraordinary, they have even gone so far as to consider the removal of a patient after amputation as a reason for delaying the operation; but, if he cannot bear removal with a clean incised wound, I should be glad to be informed from practical experience, how he will bear it, and what state he will be in, with shattered bones? The objection was invented in theory, the reply is found in practice: "That the removal, where the means of conveyance are good, is in general attended with little or no detriment, provided it be not of longer continuance than one or two days; whilst, if there be a shattered limb, the pain is horrible, the inflammation and symptomatic fever excessive, gangrene is apt to supervene, and the patient frequently never lives to the proper time for secondary operation*."

The numbers of officers and soldiers that have been removed after amputation by all the surgeons of the British army, with little or no disadvantage, entirely refute this objection; and the knowledge they have acquired of the danger attendant on the removal of shattered bones, renders them extremely cautious of doing it, even where amputation is to be the result. I have removed officers and soldiers, at all times, before and after amputation. I removed Colonel Turner†, during the first siege of Badajos, four hours after amputation at the shoulder-joint, a distance of thirteen miles, on a bearer carried by six men. During the last siege of Badajos, and that of

* See Lombard. † Since dead at Sierra Leone.

Ciudad Rodrigo, all the capital operations were performed on the field, and afterwards sent to the different hospitals, three and five leagues distant. I had officers and soldiers, after the affair at Elboden, for forty-eight hours together travelling almost constantly in waggons, immediately after amputation, without any bad consequences; but I have seen the most dreadful ones ensue after the removal of persons with shattered bones, and more especially where the injury had existed some hours. And this was illustrated particularly after the siege of Burgos, in the removal of the wounded in almost a direct march to Ciudad Rodrigo through Valladolid and Salamanca; the amputations having recovered in a very fair proportion, whilst a very severe loss followed the attempt at saving such doubtful cases of injury as were not considered proper for amputation. The great point overlooked by all these authors, is the time lost in which only the operation can be expected to be successful, but of which they were not aware.

Others state, with Mr. Hunter, "that if the patient is not able to support the inflammation arising from the accident, it is more than probable he would not be able to support the amputation and its consequences." Now, this "more than probable," on which the argument rests, is disproved by the experience of the Peninsular war; and the fact is found to be precisely the reverse, *viz.* "that a patient, who it is presumed will not be able to bear the inflammation resulting from his wound, if his limb be retained, will bear the amputation of it extremely well in most cases, and recover in a very short time, without subsequent detriment to his general health." The fact is perhaps better stated thus:—Suppose sixteen men have each a knee shattered by a cannon or grape shot, without destroying either the circulation or the connection of the limb, but in such a manner as to render amputation necessary: of these, eight shall be amputated on the field of battle, and eight delayed for amputation when the first inflammation has subsided, and suppuration is duly established. Of the first eight ampu-

tated on the spot, or within twenty-four hours after the injury, I assert, from my general experience, that on the average of three trials, six would recover; and from the same source I affirm, that of the eight delayed cases, not one half would live to the proper period of performing the operation; and of the four remaining, not more than two would ultimately recover after amputation. Instead, therefore, of agreeing with the supposition of Mr. Hunter above stated, I consider myself warranted in declaring (and I am supported in it by all the surgeons of experience in the British army) that it is erroneous; and that in any equal number of severe cases, occurring on the same day, the chance of success would be as three to one in favour of amputation on the field of battle; and the more severe the wounds, the more would this proportion be increased.

If the thigh, in the above sixteen cases, were broken at its middle, instead of near the knee, I am positive that two of the number would not live to the proper period for secondary amputation; in other words, would not outlive the inflammation arising from the accident: when one third of the number would recover, if amputation were performed immediately.

I allow amputation to be a violence superadded to the injury, a violence that occasionally destroys the patient; but it as frequently does so after secondary as primary operations, the cases being equally dangerous; but it is a violence intended to prevent a greater, which greater, the consequent inflammations and its attendant dreadful consequences, it does, in almost all proper cases, most effectually lessen, to the great advantage of the patient.

The inconvenience or danger arising from loss of substance, as far as regards the sanguiferous system, is not of much consequence after such an injury; and so far from the loss of blood being at the same time injurious, if it were only inflammation and the evils resulting from sudden loss of substance that were to be dreaded, I apprehend it would, when not in excess, be the most likely means of preventing them.

The support Mr. Hunter gave to his opinion, by stating that the experience of the military surgeons of his time, who

were esteemed the best judges, coincided with it, was fallacious; as I conceive these gentlemen did not give immediate amputation a fair trial, according to the rules of Wiseman or Ranby; or, if they did, the operation itself, or the constitution of their patients, must have been different from what we have practised, or have met with lately; or they must have had precisely the same results as we have had during the course of the Peninsular war.

I trust it will not be called presumption, thus to doubt the opinions of the military surgeons of Mr. Hunter's time; to avoid, however, the shadow of it, I will leave the argument thus:—that as those gentlemen supported one side of the question, and the military surgeons of the present day the opposite, one party must certainly be in error; and my readers will determine for themselves.

It is said to be "of less consequence whichever way it is treated, if the part to be amputated is an upper extremity." This acknowledgment of the safety of immediate amputation on the upper extremity is conceded, not in consequence of the arguments not applying, but because it was known to be a fact by the military surgeons of that time, which they could not deny, that the arm was frequently amputated with safety: the theory was therefore accommodated accordingly, for I believe there are few of these gentlemen, if there be any now living, who will deny the amputation at the shoulder-joint to be as severe an operation, in every point of view, as amputation below the knee.

But I cannot consent to receive this concession, with the incumbrance of the delayed amputation being equally successful; for I know that the amputation of the arm is as safe as any operation can be, in fair cases of injury, in nineteen cases out of twenty; and that if the same kind of cases, as far as it is possible to discriminate them, were delayed, it would not be successful in more than fifteen cases, at the utmost, out of twenty; which is a very important difference.

It is not sufficient to perform twenty amputations on the field of battle, and contrast them with as many cases

of amputation done at a later period. The twenty cases for delayed operation must be selected on the field of battle, and their result compared at the end of three months with that of the others; when the value of the two modes will be duly estimated. I have never done this exactly, because I had ascertained the safety of immediate amputation in all cases that required it, after the first battles of Roliça and Vimiera in 1808; and when circumstances would have enabled me to have done so, I did not feel myself authorised to commit murder for the sake of experiment; but I have had at various times a great number of unhappy objects under my care, who ought to have suffered amputation on the field of battle, but which circumstances did not permit, and most of these died; whereas, those men who were wounded on the same day, and who suffered amputation shortly afterwards, for the most part recovered. Of a number of doubtful cases, in which I tried to avoid amputation, and not extending the trial beyond what the situation of the patient would allow, I lost a much greater proportion than I did of those who were amputated on the field. It is true, these men had a chance of saving their limbs, and in taking this chance they lost their lives; but they would not the less have done so, if they had from the first been considered as incurable cases, waiting only the proper period for amputation.

Officers, who may be considered as persons in the highest health, very seldom die after amputation of the upper extremity; or below the middle of the thigh, when done within twenty-four hours after the injury; indeed I hardly know an instance of it in the upper extremity, without there being reason to expect it prior to the operation; and on the lower extremity, the success, as far as I can judge, has been in a greater proportion than that of primary amputations of troops in general; proving the great advantage of immediate operation, when undertaken with proper care, even in the most healthy subjects.

The following statements of operations, performed on the field of battle, and at a subsequent period in general hos-

pitals, in the army in the Peninsula, which were collected by Sir James M'Grigor for the purpose, fully bear out the opinions above related.

Return of the Capital Operations performed at the Hospital Stations, between the 21st of June and the 24th of December 1813, of the Army under the Command of his Excellency Field Marshal the Duke of Wellington; being a period of Six Months, from the advance of the British Army from Portugal until its establishment in Winter Quarters in front of Bayonne.

	Number operated upon.	Of which died.	Discharged, cured.	Under Cure.
Amputation of the Upper Extremities.	296	116	105	75
Lower Extremities	255	149	65	41
Total number of Operations	551	265	170	116

The operations at the shoulder-joint not included.

Return of the Capital Operations performed in the same Period on the Field of Battle, and for the most part kept in Regimental and Divisional Hospitals.

	Number operated upon.	Of which died.	Discharged, cured.	Under Cure.
Amputation of the Upper Extremities.	163	5	64	94
Lower Extremities	128	19	43	66
Total number of Operations	291	24	107	160

The cases marked "under cure," in both statements, having passed the period of danger, are considered as recovered; and from this it will appear, that the comparative

loss, in secondary or delayed operations, and primary or immediate operations, is as follows:

	Secondary.		Primary.
Upper extremities.....	12	*to*	1
Lower extremities.....	3	*to*	1

This difference is certainly very remarkable, and it is so well known to all the surgeons of the British army, as a constant occurrence, that there is no longer among them any doubt on the subject.

In a report made by Mr. Gunning, the Surgeon-in-chief, to Sir James M'Grigor, on the wounded after the battle of Orthez, he states, that on the 24th of March, one month after the affair, the loss from amputation had been one in twenty of the upper extremities, and one in nine of the lower extremities; and that of eight hundred wounded on that occasion, fifty-one only had died.

Mr. Mann, Hospital Surgeon to the American army, during the war on the Canadian frontier, in 1812, 1813, and 1814, and who has published a work entitled "Medical Sketches" of these campaigns, admits the propriety of immediate amputation, in cases where the operation is inevitable, but is disposed to regard the secondary operations in a more favourable manner than surgeons do in Europe; but his practice appears, from his own statements, to have been very limited.

When a soldier must die retaining his shattered limb, in a few hours or days, and there is a chance, however small, of saving his life by removing it; this chance and the prospect of success are to be explained to him, when the man will generally decide for amputation. In this manner, several limbs are amputated, although the prospect of success is but small, and the number of fatal cases are increased; whereas, if those only were calculated, which might be considered good cases for amputation, as is generally done in domestic surgery, the average of success would be infinitely greater. Many operations, both in the field and in hospital, are forced upon the military surgeon, that he would willingly avoid, but he has not conscientiously the means. A soldier, in addition to a

bad compound fracture of the thigh, above its middle, has a considerable hæmorrhage, from a deep-seated artery or vein, and this may happen in the field of battle, or in hospital; is he to die unaided, because amputation near or at the hip-joint is generally unsuccessful? or is he to have that chance of life if he is anxious to undergo the operation? A military surgeon, in these cases, has no alternative; for a soldier ought never to die without surgical aid, where there is a chance of its being successful. This kind of cases will very much decrease his average of success, but he will have done his duty.

Considerable stress has been laid upon the inconvenience of situation for performing operations, the irregularity or disorder of camps, of besieged towns, of the want of comfort, or proper accommodation for operating, and other reasons of the same description, why amputation should not be performed in the field of action; but all this is fanciful; they may be insuperable difficulties to a surgeon accustomed to the conveniences of civil life, but are by no means necessary: indeed, in the education of a military surgeon, he should never be taught to expect any convenience; his field pannier for a seat for the patient, and a dry piece of ground to spread his dressings and instruments upon, are all that are required. It is needless to discuss this point further, as a reason why any operation should be postponed.

A due consideration of all these circumstances induces military surgeons to divide the operations of amputation into Primary and Secondary.

Primary, when performed within forty-eight hours after the receipt of the injury; or before the constitution has become affected in consequence of the accident, or inflammatory action in the part, constituting symptomatic fever.

Secondary, when performed after this symptomatic fever has continued some time and subsided; suppuration being fully established, the strength of the patient considerably reduced, and the powers of nature found incapable of effecting a cure, or of supporting longer the disease without material disadvantage; which in general is a period of from three to six weeks.

Of Primary Amputation.

When the surgeon is satisfied there is no chance of saving the limb by prudent delay, the operation is to be performed as soon after the receipt of the injury as the state of the patient will permit; the only point to be considered is, if the patient has so far recovered the shock of the injury as to be able to bear the additional one of the operation. This depends on the different powers of constitution in individuals; for two men may have the leg torn off below the knee by the same shot, or at the same time, under precisely similar circumstances; one shall recover from the alarm given to the constitution, and undergo the operation within the hour with advantage, whilst the other may not be in a state to bear it for a longer period. And if this man be operated upon immediately after the accident, without due attention being paid to the state of the constitution, under the idea that the removal of the injured parts will remove the nervous affection, the consequences in many instances will be fatal.

When, after an accident of this kind, below the middle of the thigh, the general alarm has a little subsided, and the patient is made acquainted with the extent of the injury, he knows he has at most only lost a leg, and with this knowledge he is unconsciously tranquillized, the pulse becomes more regular, the confused sense of the blow remains, but the pain is seldom great, and is in general more a painful sense of numbness than absolute pain. In this state he is brought to the surgeon, requiring to be relieved from danger; and that of bleeding to death, &c. presses on his mind, until his wound be examined. The anxiety is now momentarily increased, and with it a false feeling of strength and courage, that renders him desirous of undergoing any operation that may be necessary. He may now bear the operation very well, but it is not always the best time for doing it: the surgeon should endeavour still further to sooth the mind of his patient, by explaining to him the nature of his wound, and

by promising him the necessary assistance in due time. The confidence in obtaining surgical aid, and the knowledge of being in safety, will gradually tranquillize him, his pulse will become fuller, the agitation both of mind and body will decrease, the countenance become more natural, the voice more equable and clear. He now anxiously desires the operation, to relieve him from the increasing uneasiness in the part affected; and it will be borne with every chance of success.

Soldiers in general are anxious to undergo an operation when they find it inevitable, and frequently press it before the proper time, that is, before they have sufficiently recovered the shock of the injury; and if attention be not paid to support them afterwards, they sink and die, as in the case related page 208, and which is better seen in the following:—

Lieut. Colonel Sir James Douglas, during the action of Toulouse, had his leg carried away close to the knee by a cannon-shot, so as to render amputation necessary; he suffered less than is usual from the constitutional alarm on the receipt of such an injury; or rather, as soon as he was aware of his precise situation, and found himself within reach of surgical assistance, he endeavoured to command his feelings, and pressed to have the operation performed. His thigh was cut off, a little above the knee, in about an hour after the accident, which he bore very well, and was placed on his bed, like other wounded men, in a house at hand, in charge of an assistant surgeon: this occurred in the evening. I rode up to the house next morning to inquire about him, and found he had not slept during the night, that towards morning he had been more restless, and was sixteen hours after the operation in a very alarming state; the pulse very quick and weak, the skin clammy and wet, the stomach rejecting all the light drink offered, and he was suffering considerable anxiety from the idea he entertained of his situation. I ordered him a wine glass full of two-thirds French brandy, and one of water, which remained upon his stomach. His confidence in the gentlemen who shortly afterwards visited him helped to relieve his mind,

and a repetition of the warm brandy and water from time to time during the morning banished the bad symptoms; a little broth stayed on his stomach in the evening, and the cure went on without further inconvenience from debility or symptomatic fever. The muscles retracted, however, considerably after the operation, the bone protruded, and the cure was not completed for some months.

I think I saved this officer's life; for, if he had been neglected an hour longer, his fate would have been decided. It is necessary, therefore, to watch all cases of primary amputation carefully, and guard against accidents of this kind, by supporting the patients with some cordial as their strength appears to fail. It must also be remembered, that it is more likely to occur after amputation of the thigh, than of the arm.

When a limb has been torn off by a cannon shot, the state of the patient will, in the generality of cases, be such as has been described; sometimes, and especially when it is the thigh that is injured, the nervous commotion will be much greater, the pain considerable, and gradually increasing; so as to cause the patient to claim relief, not from the calm courage of a man who is desirous of undergoing an operation he cannot avoid, but from the suffering being so intolerable, that it cannot be borne. The operation is then to be performed *immediately;* for, although the patient may appear unable to bear it, the shock of the operation will not be equal to the continuance of the suffering he is undergoing, which would soon prove fatal. The operation may do so likewise, but it is the only chance of safety, and will in general bring immediate relief, even if the patient sink under it afterwards. These cases are not of frequent occurrence, there is in general a certain period, differing in different persons as to time, before these symptoms come on, and they are then severe in a greater or less degree. Severe twitchings of the limb, violent pain and convulsive motions of the body, indicate considerable danger; as do, in a greater degree, a total absence of these symptoms, with great prostration of strength, irritability of stomach,

clamminess of the skin, and aberration of mind. — A moderate sense of pain, and apparent recovery from the first alarm and nervous commotion, give the most favourable prospect of success after amputation.

I believe it to be a stretch of fancy in those surgeons who conceive, that if the knife followed the shot in all cases, the patient would have the best chance of success. No one will deny, that if the shot performed a regular amputation, it would not be better than to have to do it afterwards; but if they mean to say the operation should in general be performed immediately after the injury, I can only oppose to them the facts above stated, and the general result of my experience, which is decidedly in favour of allowing the first *moments* of agitation to pass over before any thing be done; a period extending from that, to one, six, or eight hours, according to the difference of constitution and the different injuries that have been sustained. But from one to three hours will in most cases be found sufficient.

When the due period of operating is observed, the bad consequences which are supposed by authors to ensue do not occur; the symptomatic fever seldom runs high, it is in general moderate, and after an amputation of the upper extremity is frequently trifling; and this is to be accounted for from the parts only taking on such actions as are necessary for the cure of the stump, and the powers of the constitution having been weakened by the shock of the accident and of the subsequent operation. Suppurative inflammation is in a great measure avoided, the bone is in general well covered, and the cure is completed in the space of from three to five weeks. Venesection is sometimes necessary. Spoon diet, or a total abstinence from solid food, with occasional cathartics, should form the general plan of treatment: opiates where there are spasmodic affections of the limb, and a more generous diet if there be much debility. If the symptomatic fever runs high in a robust man, blood is to be taken freely and with effect from the arm, cold water ought to be applied to the stump, and the antiphlogistic

mode of treatment rigidly enforced; and especially the blood-letting, which is to be repeated on the first two or three days, until the increased arterial action be reduced. The antimonium tartarisatum will be found very useful in small doses, so as to nauseate the stomach and affect the bowels, which must be strictly attended to from the first.

Secondary hæmorrahge seldom occurs after primary operations. Retraction of the muscles and exfoliations of bone are not frequent, unless some untoward accidents happen after the operation, in moving the patient; or there have been errors in the performance of it, inattention in bandaging the limb at the subsequent dressings; or accidents from fever, or other causes in hospital, which are foreign to the operation. The greater proportion of those who die after primary amputation, die within the first twenty-four hours.

Inflammation occurring in other parts of the body, and particularly in the viscera of the thorax and abdomen, during the cure of a primary amputation, is very rare. After the first few days the patient feels much debilitated, and continues so in successful cases for some time after the stump is healed. It is, indeed, generally from three to six months, before the patient is as strong or as fat as he was prior to the operation; and I do not believe, that, in young men, any evil consequences result to the system after the period of cure from the loss of a limb.

I have met, since the peace, many men whose limbs I amputated after the battles of Vimiera, Talavera, &c. at the beginning of the Peninsular war; and I do not find they have suffered any inconvenience in their general health.

The nature of war on a large scale, often renders it impossible to perform all the amputations required, before inflammation has commenced in the seat of injury, and considerable fever has ensued, which is generally the case when the enemy leave their wounded on the field of battle without surgical aid, as the French invariably did when opposed to us in the Peninsula. These unfortunate people could seldom be

collected in hospitals before the third or fourth day, and between that and the twelfth or fourteenth, many operations were indispensable to give the patient a chance of life. Of these cases, were limbs torn off, bad wounds of joints, compound fractures by cannon-shot, wounded arteries causing mortification of the extremities, or other severe injuries, from which the soldier claims relief by operation to save him from inevitable death, before the suppurative inflammation shall have come on, and duly subsided; which is then the most advantageous period for amputation, and ought to be waited for, if the patient's strength will permit, in all cases, excepting those of wounded arteries inducing gangrene.

Sooner or later, after the receipt of an injury rendering amputation necessary, if it be not performed, pain, heat, redness, and tumefaction of the neighbouring parts, constituting inflammation, come on, which speedily runs into suppuration or gangrene; depending considerably upon the nature of the injury, the parts injured, the constitution, habits, age, and disposition of the patient, independently of the adventitious and frequently unfortunate circumstances of situation, surgical attendance and aid, which decide in a great measure the fate of the patient. The constitution sympathizes with the local injury; as the inflammation increases in the limb, the symptomatic fever becomes more violent, and if relief is not obtained, frequently ends in death in the course of a few days. The local inflammation appears to be augmented in turn by the fever, and extends far from the seat of injury; the temperature of the limb is increased, the tumefaction and redness are considerable, the pain generally intolerable, the limb will hardly bear to be touched, and far above the injury will be much firmer on pressure, and larger than usual. If the integuments of the thigh be cut into in this state, when the wound is in the leg, they will be found full of fluid partly coagulated, especially upon the under part; they will not retract from the muscles, on being divided, which are fuller of blood in consequence of the increased size of the

smaller arteries; and the stump thus made will not unite by adhesive inflammation. The symptomatic fever is much increased after the operation, and frequently proves fatal; and in the autumn, in Spain and Portugal, would occasionally take on the form of the bilious remittent endemic of the country, which very much increased the danger. In fact, when the injury has been severe, amputation at this period is attended by all the bad consequences enumerated by authors; and it is from their having been performed at this period, and confounded with operations performed prior to the constitutional derangement taking place, that the prejudice against immediate amputation has arisen.

When the local inflammation and symptomatic fever run high, both are to be moderated by a total abstinence from solid food, by blood-letting, purgatives, and diaphoretics; cold water is to be applied to the limb, and the heat reduced by constant evaporation. If the symptomatic fever is not reduced by these means, venesection is to be resorted to every six or eight hours; leeches to the part affected will at the same time be of infinite service, and in combination with the general means probably prevent gangrene. These being continued for the first five or seven days, in different constitutions and habits, the ulcerative process for the separation of the dead from the living parts will be very observable, although the discharge may be small; the skin will be stiff, a sense of tightness, throbbing, and uneasiness, will be felt by the patient in the limb near the injury, which the cold applications appear to increase. Warm fomentations and poultices are then to be applied for a few days, when suppuration will readily be brought on, and the general uneasiness diminished. During this period, the greatest attention must be paid to the state of the bowels. Opiates may be given to relieve pain and procure sleep, and good light nourishment is to be allowed.

Under this treatment, the patient will sink and die, or he will arrive at that state usually described as advantageous for

operating. At this period the suppuration will be good, the separation of the dead parts accomplished, the tumefaction of the limb diminished from the absorption of the effused fluid, the strength and health of the patient much reduced, the fever abated; and only a general irritation remaining, from the powers of nature being unequal to the cure of the injury, constituting hectic fever, under which the patient would soon sink, unless the seat of disease is removed by secondary amputation; and this period will arrive in severe wounds from the third to the sixth week. It ought to be clearly understood, that a limb is to be amputated at this period only because the health and strength are sinking under the disease, the powers of nature being unequal to its removal or support.

Many bad wounds will never reach this secondary stage, especially in the summer season; and if the patients outlive the first symptoms, they will not outlive the operation. I had satisfactory proof of this after the battle of Salamanca, in the French soldiers brought into our hospitals on the third and fourth day after they had been wounded; they were compound fractures, requiring conveyance, and could not be removed sooner. Of these I had 150 in the most deplorable state; from the constant exposure to a burning sun, their sufferings had been horrible, and they earnestly prayed to be shot, or to have their limbs removed. There was little hope of saving either the lives or the limbs of the greater part of them, and few had any prospect of living to the proper period for secondary amputation. Forty-six of the worst of these wounds were amputated in the course of the next fourteen days, nearly all at the thigh; of this number I saved but six, and these six may truly be said to have been saved, for of their comrades who were not so severely wounded, and who were not operated upon, as few in proportion survived. If I argued upon these cases as of primary operations, I should draw as false conclusions as the advocates for delayed operations have done in many instances. I allow that most of them were not cases of secondary amputation, and I do

not adduce them as such, but to exemplify the fatality of not operating on the field of battle without delay; for if these men had had their limbs removed on the first or second day, and still remained as they did on the field of battle, with a little cold water to wet their stumps, I have no doubt the result would have been very different, even under equally unfavourable circumstances during the remainder of the cure.

I have confined the period for primary operations to the first forty-eight hours, not with the view of marking an absolute time beyond which they should not be done; but as a guide to young practitioners under circumstances of difficulty, and in making up general returns; for the physician or surgeon knows nothing of hours, he judges from symptoms only, and acts accordingly. This was so obviously my opinion and intention, that if an impartial reader will take the trouble to examine the text with attention, he will find, that wherever I have mentioned hours, I have never positively confined myself to any one. I have, on the contrary, in the same sentence, purposely made use of the terms from one to six or eight hours, and from one to three hours, and in page 164, an hour or two; which, if I had placed any dependence on time, would have been very culpable negligence. In mentioning even one hour, I was only desirous of specifying some short period of time, inasmuch as an operation of this nature (except perhaps the first), under any of the usual circumstances of a regular engagement, is seldom performed until half an hour has elapsed; and in the commencing paragraph, in order to prevent the spirit of my direction being misunderstood, I said WITHIN THE HOUR, meaning thereby, as every impartial man will, I think, conclude, as short a time as I conceived an operation was likely to be done in; in other words, as the title of my book imports, immediately or without delay. The gentlemen who have misunderstood and consequently misrepresented my opinions, are Messrs. Hutchison*, Quarrier†, and Dewar‡. Mr. Hutchison published two works, one in 1816, the other in 1817; and it is proper here to state, in order to give due force to my observa-

* Some practical Observations in Surgery, by A. C. Hutchison. 1816. Some farther Observations on the proper Period for Amputating, 1817.

† Dr. Quarrier's paper in the eighth volume of the Medical and Chirurgical Transactions.

‡ Dr. Dewar's Account, &c. in the Medico-Chirurgical Journal for April 1819.

tions, that I am authorized by Mr. Williams, Surgeon to the Forces, now at Bermuda, to say, that before Mr. Hutchison published his first book, he told him he had misunderstood my opinions, that I never could intend to write what I had never practised, and that it was only in certain cases I recommended any delay. At this period I was not acquainted with Mr. Hutchison, but hearing from Mr. Williams of this objection, I took the earliest opportunity of making myself known to him; and before he published his second work, the pamphlet connected with the medical account of the expedition to Algiers, I repeated to him myself Mr. Williams's remark. In continuing his observations on this subject, after my intimation to him, I can hardly consider them as applying to myself, and desirous to avoid the appearance of a controversy among officers alike in the public service of the country, I refrained from taking notice of them. As the opinions impugned are, however, of considerable importance, I can now, I conceive, in a second edition, inquire into the objections with propriety, and without making particular personal allusions, which are always disagreeable, and never serviceable to the interests of science.

It never entered into my contemplation, that any persons could suppose, after giving the general rule for amputating within the hour, or with as little delay as I thought must naturally take place, that any exceptions to this could be erected into the general rule itself; and when they were especially made for cases in which great commotion should be observed, or shock from the blow, &c. that the exception, for these cases, should be applied to others in which no such circumstances occurred. This has been done, and all I can say to it is, if gentlemen will not use the exception for the purpose I have made it, but apply it to others, and then argue upon it, that they are not overturning my opinions, but fighting some of their own creation. I endeavoured, after giving the general rule, to make some particular exceptions, and to describe some of those awful cases I had seen, which depend much on the nature of the constitution of the patient, as well as on the nature of the accident.

On reading over the different remarks that have been made upon my observations, I have been, I must confess, a little surprised and amazed, at the construction which has been put upon them. In one place, in arguing against any delay, one gentleman gravely inquires, "What man can bear the pressure of a tight ligature, like the tourniquet, on a wounded limb for four or six hours?" To which question I would reply, by inquiring, what sort of a surgeon must he be who recommends it to be left there, and in what book such a direction is to be found? I am made by another gentleman to signify, that a surgeon,

on having his wounded brought to him, is to take out his watch, or wait with impatience four or six hours, for the proper time of operating, without considering or inquiring in any way into the state of his patients! To the gentlemen who served with me, and recollect the particular decision and dispatch which marked all our proceedings on those occasions, this passage, as applied to me, has appeared truly ludicrous; but I have always told them, that if gentlemen will raise phantoms in their own imaginations, they must in due time exorcise them also.

When I said, the nearer a person was to a good state of health, the better he would bear an amputation, I did not conceive it could be disputed; but as it is disputed, the point must be contested, and I beg to ask my opponents one question, which, as it is a personal one, must, I think, be decisive. If they had their choice of the manner in which they would suffer an injury at the middle of the thigh, that should render amputation necessary, which would they prefer, to have it shattered by a cannon-shot, which should not, however, injure the principal artery, or to have the bone broken in such manner by a musket-ball, as to render the same operation requisite? That they would all prefer the latter, if they wished to recover from the operation, there cannot be a doubt; and for my own part, who have seen many such accidents, and known the results, I would rather lose a considerable quantity of blood in addition from the principal artery of the limb, than suffer the blow from the cannon-shot, even if the artery remained entire. If they choose the injury from the musket-ball (and no one will believe them if they do not), it must be, I conceive, because they admit that the injury has been effected with the least general disturbance. If this be admitted, the objection falls, with the admission: or, suppose a man was obliged from arbitrary power to lose his thigh, is there any man living would think himself more likely to recover from having it first shot off and then amputated, than from undergoing the operation in the usual manner?

A soldier of the 7th hussars, at the battle of Toulouse, was struck on the fore part of the thigh by a cannon-shot; the limb was evidently destroyed; and, as the man was suffering very much, Dr. Hume, who saw him a few minutes after the accident, requested me to assist him in the operation. It was not his business, as surgeon to the Duke of Wellington, nor mine, as the principal medical officer present on the field of battle, to do it; but we were influenced by feelings of humanity, and a conviction that the man could not live, if he did not obtain relief. As the leg was sawed off, a French nine, nearly a twelve pound cannon-shot, fell out from between the muscles, and as the last strap of plaister

was applied, the man fell back and expired. He had not lost much blood; Dr. Hume had operated; it was impossible it could have been done better or more quickly. Why did he die, or wherefore? If he had been wounded by a small grape or musket shot in the same place, rendering amputation necessary, he would in all probability have lived, whether the operation had been performed at the time it was done, or two or three hours afterwards.

There is an incalculable difference, on many occasions, between the effects of an injury by cannon and musket shot in the same part, and again between the upper and lower extremities; so much so, that in my observations on Primary Amputation, I have never alluded to wounds from musketry, excepting those of the shoulder-joint, but always to serious wounds from cannon-shot, or shells. This may not perhaps have been observed; and when I have been alluding to very serious injuries of this nature, my arguments have been often opposed by the circumstances stated to have attended wounds of the metacarpal bones, wrists, or other parts of comparatively trifling importance. Wounds of this nature I did not notice, I put them entirely out of the question, for I do not believe that the delay of an hour or two, more or less, interposes any way in regard to the certainty of the cure. I am firmly of opinion, that if twenty men, in perfect health, were to have one arm each amputated within ten minutes after the receipt of an injury rendering such an operation necessary; and twenty more affected in the same manner, at the end of four hours, as many would survive one set of operations as the other. I am so certain of this fact, that I consider it my duty to impress it strongly on the minds of students, "that after an action, they should never amputate arms, whilst there is a patient present who requires that operation on his leg or thigh; and an operation at, or on, the shoulder-joint should always give place for the same reason to one on the thigh. Injuries from cannon-shot should be attended to, before those from musketry, although both may equally require an operation; indeed, it should never be forgotten, that in the greater number of cases of wounds from musket-balls, it is not the present injury, but the knowledge acquired from repeated observation, of what must ensue at a more distant period, that induces us to amputate. In cases from cannon-shot, it is the present injury which demands relief, as much as the knowledge of what may ultimately occur."

When, then, I mentioned the effects of cannon-shot on the system at large, after a *severe* injury, I was not writing gratuitously or hypothetically, but from what I had actually seen on very many

different occasions, I never said that all men suffer alike, or that a trifling injury produces the same effect as a serious one: on the contrary, I expressly stated it to be otherwise; but I do, and always will maintain, until I lose my senses, and the recollection of many a well-fought day, that no man ever lost his leg or his arm by a cannon-shot without knowing it, without a sensible alteration taking place in his countenance, in the state of his pulse, in his manner of speaking, and oftentimes of acting. I have seen one man cry like a child, another roar out like a boy under the rod, a third fall to the ground calm and resigned to his fate, a fourth become nearly insensible, whilst a fifth has only cursed or sworn, and threatened the enemy, although his countenance belied his power of action. This is what I have called the shock and alarm which is experienced to a greater or less extent, on the receipt of an injury by cannon-shot; and so far from leaving it a vague, undefined, or ambiguous expression, as I have been accused of doing, I have, on the contrary, most pointedly mentioned the symptoms by which it may be known. I have, also, drawn two distinct and different outlines, requiring an opposite mode of treatment, pages 48 and 51 of the first edition, and pages 231 and 233 of the present. I have never then said the same symptoms occur in every case; but that they do not occur, are not always alike, and require a different mode of treatment. In one kind I directed immediate amputation as the only resource, in the other I advised a prudent delay and the administration of cordials.

In order to prevent any error, I said, page 164 of my first edition, that it was in cases of injury of the thigh, that the question of time was most important, and for fear I might be misunderstood upon that point, where it was of the greatest consequence to be correct, I again enumerated the symptoms that required delay, and clearly distinguished those that did not admit of it. Of this paragraph I do not wish to alter one word, it runs as follows:—"These cases (alluding to severe injuries on the upper part of the thigh) prove, that the operation is not only necessary, but practicable, and that it may be effected with success under certain circumstances. This being granted, it necessarily follows, that the operation ought to be recommended and performed in every case in which it can alone bring relief, or offer a prospect of success. No man should, therefore, be allowed to die without its being proposed to him; and if it be a case for primary operation, the sooner it is done on the field of battle, consistent with propriety, the greater will be the chance of success, for the patient cannot live to the period for secondary amputation. It is in this and other operations high in the thigh that the question of

time is most important, for haste is as injurious as delay, when improperly applied.

"If the patient has suffered much loss of blood, or is in a state of syncope, or nearly approaching to it, unable to articulate, with a pulse scarcely perceptible, and the skin clammy and cold, an immediate operation would only hasten his death; but if excited by stimulants and cordials, he would have some chance of recovering himself in an hour or two, so as to undergo the operation with a better prospect of success, or he would in that period sink and die. If, on the contrary, he is brought to the surgeon, although much alarmed and reduced by the sudden shock and loss of blood, with strong sensations of pain, expressed by his cries for assistance, convulsive motions of the limb and body, and the powers of the sensorium not destroyed, the operation should be performed immediately; or, instead of becoming more calm and collected, he will gradually sink into the state of the first described, and be unable to bear the operation. On the other hand, the first mentioned, if he be excitable, will in time rather approach to the state of the latter, and from the pain, &c. he suffers, will call for the performance of the operation. This violent nervous commotion, however, is not common; it depends upon particular idiosyncrasies, and will never in the first be so excessive as in the last."

I did not conceive it possible to mistake this plain statement, or that any body could suppose it to be applicable to persons who had none of the symptoms mentioned in it. And that people having few or no symptoms should wait six hours for the proper time of operating, appears to me so strange a doctrine, that I can hardly believe they thought me capable of promulgating it, any more than I can believe they could think I intended they should cut off legs and arms that had not sustained an injury. They have overlooked the two states I have described, and which are so diametrically opposite to each other, one being of direct debility, approaching to a state of syncope, the other of great nervous irritation, combined with a certain degree of commotion, but accompanied by pain, or, as Dr. Dewar in his paper says, "of acute anguish from the wound."

At page 51 of the first edition, and page 233 of the present, the paragraph to which Dr. Dewar has alluded will be found, commencing "When a limb has been torn off," and ending, "after amputation." The tenour and object of this paragraph is to inculcate the necessity for immediate operation, and not to delay with the hope of the subsidence of this irritation. It is opposed to the state approaching to syncope; and how any part of it can, in any manner, be construed, as recom-

mending delay, or as applying to the other state, I cannot comprehend. Dr. Dewar has, also, divided the passage, and taken only a part, which alters the sense of it. The passage he has referred to stands thus:— "These cases are not of frequent occurrence: there is, in general, a certain period, differing in different persons as to time, before these symptoms come on, and they are then severe in a greater or less degree." The whole paragraph refers to persons brought to the surgeon immediately on the receipt of an injury by cannon-shot, which has torn off the limb, the "certain time" referred to is only of a few minutes, for the whole period of conveyance is not supposed to include more than half an hour. The first sense of the limb being torn off is that of a dreadful concussion having been received; the sensation of pain follows; and, whether the patient is to fall into a state approaching to syncope, and die, or to recover and become calm, or to fall into a state of anguish and nervous irritation, which makes his situation unbearable, are points not to be foreseen, but to be ascertained from observation; and some minutes at least are required to make it, perhaps a quarter of an hour, for time appears to pass quickly under these circumstances. It will also be recollected, that I have expressly said, "these cases are not of frequent occurrence;" and how any man can apply the observation to *all* cases, or conceive that I supposed the certain time meant four, six, or eight hours, is beyond my comprehension. The only way I can account for it is this; that, having first supposed I intended that all cases, of whatever description, should be left for four, six, or eight hours, waiting for operation, the idea of controverting it became so strong, that it prevented their judging fairly of the exceptions I had made, or of the peculiarities I had described.

When the thigh is torn by a cannon-shot, or shell, there is always more or less loss of blood, it is sudden and soon ceases, as the system cannot support the rapidity with which it is discharged, especially near the centre of the circulation. There is a sudden change in the action of the heart; the blood is not propelled with vigour, the hæmorrhage ceases, and this is not a little aided by the sudden effect produced on the whole human being, in consequence of the blow, independently of other local causes. That this general effect is produced, is proved by this circumstance; if a man has the femoral artery fairly divided by a musket-ball, he will often bleed until he faints, but he will seldom or never die: but when this takes place from a cannon-shot, the patient will often die, whether he suffer amputation or not. Can this be accounted for in any other way, than from the general derangement caused by the shock of the blow, and the tearing away of parts? It

is the double effect on the nervous and sanguiferous systems, which I called shock and alarm, and to which, in a case of this kind, many persons owe their lives, for without it they would bleed to death; with it the hæmorrhage ceases. I do not believe, that, during the whole course of the Peninsular war, a tourniquet was applied in one case in ten where limbs were struck by cannon-shot; and when they were applied, the greater number were useless. The time required to get the better of this state is various, and, where much blood is lost, the effect on the nervous system will be greatest. Mr. Hutchison admits, page 11 of the pamphlet, that "the general effect of a sudden abstraction of blood from the system, is feebleness of pulse, pallid countenance, faintness, and even syncope; but all these apparently alarming symptoms are speedily removed by administering some generous cordial, as wine, diluted brandy, &c." Now, almost every student knows, when these symptoms follow the loss of blood after a severe injury or operation, that they are not so speedily removed; but this is nothing to the remark which follows; he says, "To these occurrences we cannot justly apply the doctrine of shock and alarm to the constitution, and, in fact, need not retard the operation beyond the period necessary to rouse the dormant powers of the system, by the means already pointed out, and which at most require not many minutes to effect." Now, it often happens, in contradiction to this statement, that no administration whatever of wine or cordials will rouse the dormant powers under these circumstances, and the patients die without an effort at reaction. If syncope, resulting from sudden loss of blood, be not a shock and alarm to the constitution, I really should like to know what is. Can any thing cause a greater shock for the time being, save death itself? What can we all think of ourselves, who have stood by offering unavailing assistance, and seen our patients die, after a severe injury and sudden loss of blood, when we are told that such people might have been restored, and rendered fit to undergo an operation in a few minutes? In what part of my book have I declared the effects of a great loss of blood not to be a principal cause of the alarm and shock to the constitution? The answer must be, in no part, and that I have actually mentioned the very same symptoms as resulting from it. If, then, it be acknowledged, as it has been, that time must be allowed, and cordials given, to rouse the dormant powers of the constitution, my point is gained; and whether this takes up a few minutes, or one, two, or more hours, is a matter of indifference to me, and will become one of observation for those who have to perform the operation.

I have noticed in several places, nervous commotion, alarm, affection of the sensorium, as connected with debility and syncope, the result of blows from cannon-shot. By these words I meant at most, a temporary suspension of the faculties of the mind, or inability in exercising them, not that the persons become delirious or insane; and if any one has really expected to see such derangements from what I have said, I can only say, he expected a great deal more than I had any intention he should have done.

Mr. Hutchison has endeavoured to prove two points against my observations:

First, that there is no shock or commotion whatever after an injury from cannon-shot.

Second, that I have advised delay under all circumstances in which amputation was inevitable.

I have sufficiently disproved the last, and I should suppose the first also, and only now notice it to correct an error which bears upon the subject, with reference to the case of Colonel Beckwith, whose meaning he must have mistaken. He says, this gallant officer was totally unacquainted with his calamitous wound, till informed of it some time after by a staff-officer, who first called his attention to the circumstance, on perceiving a stream of blood flowing from the boot and stirrup-iron to the ground; and, after such a lapse of time, the loss of blood must have been considerable, which produced some degree of faintness. I have Colonel Beckwith's authority to say, after reading this passage over to him, that it should stand as follows: "the sound of the coming shot, the blow, the sense of it, the bleeding, and the calling out of my friend, were as two seconds of time on the watch." The shock and alarm which immediately followed, the Colonel acknowledges, and very expressively says, "You doctors may call it fright, if you please;" but fear, on an occasion of this kind, never occupied a place in the breast of our friend.

Reference has also been made to the works of Baron Larrey, but he speaks of the "commotion violente, commotion générale, stupeur de tout le membre, &c." which ensued after injuries from cannon-shot; and if these words do not correspond with what I have intended to signify by shock and alarm, I do not understand what they do mean. The cases of the Generals Lanusse and Sylly have also been quoted from his works, tome ii, page 260, in support of instantaneous operation, and as proofs of the absence of all shock and alarm, but with very little precision.

"General Lanusse was wounded by a bullet of small size, which

passed through the knee-joint; the articulating extremities of the bones were broken, and the thigh-bone fractured to some-distance; the popliteal artery and nerve were divided, the loss of blood was considerable, and the *commotion violent*. I proposed to amputate the thigh, as the only means of saving his life; but he refused, not wishing, he said, to survive the misfortunes of the day. Eight hours after, at the entreaty of his friends, and when suffering dreadfully, he sent for me. I found him of an icy coldness, with hiccup and anxiety, paleness of countenance, and insensibility of the wounded limb. The miserable state of the pulse gave me but little hope of saving this officer's life; there was, however, some chance, that the operation, in removing the sphacelated member, might diminish the pain, and reanimate his drooping spirits. The amputation was done in less than three minutes, and was followed by the relief I had hoped for; but the vital powers were exhausted, and he died the same night."

The operation in this case was urgently required, on the principles I propose, within the first hour, and long before the dreadful sufferings were allowed to exhaust the patient. It also was required on my principles, because the artery and nerve were divided, and mortification must ensue. It proves, that the shock and alarm which has been denied occurs, and is noted by other surgeons. In what respect, then, it can be brought against my observation, I have yet to learn. If it be said, it shows, that if the patient be left, and the operation be delayed for eight hours, he will not be able to bear it; I agree to the assertion, and have, in the passages alluded to, most distinctly said so. Vide page 164 of the first edition, and page 235 of the present.

General Sylly was wounded by a cannon-shot, which nearly carried away the leg at the knee, it being attached to the thigh only by some of the tendons and ligaments, which were not entirely destroyed. He desired that he might be carried to the hospital establishment in the centre and rear of the line; but the extreme state of weakness to which he was reduced, in consequence of the great loss of blood, prevented his becoming acquainted with the extent of the injury he had received. He was not even aware of the amputation of his leg, which was done on the spot, on account of the swelling and stupor of the whole limb. This officer recovered, although more than sixty years of age.

This case more particularly, if possible, marks the commotion and stupor of the limb, than the other; and as a state of swelling, "état d'engourdissement," had taken place, some time must have elapsed

before he reached the hospital establishment. The Baron Larrey amputated forthwith, and succeeded. I have done so too, and I have also failed: on which account, in such a case, I should have preferred the administration of a cordial, and a certain degree of consequent restoration, before I operated. The surgeon must in these cases use his judgment: he must not err on one side or the other. The proper time for operation in such a case, according to my opinion, is when the patient has gradually recovered, and begins to feel the injury he has sustained. Let this case be compared with the case of the soldier of the 7th hussars, page 241. Under these circumstances, a certain degree only of recovery can be expected; and if any one should expect more, he must be a very extraordinary man.

In regard to the official reports of the results of operations after the action at Algiers, it is not necessary to make many observations, as the preceeding remarks apply to the arguments which have been advanced.

Mr. Hutchison argues, with reference to these persons, and especially to the wounded of His Majesty's ship Leander, and which Dr. Quarrier, the surgeon of that ship, confirms, that there was no appearance of shock and alarm to the constitution, and consequently no nervous commotion. Yet, as four men died shortly after the operation, one is naturally induced to inquire, why they died? and the answer must be, in consequence of the operation; for it could not be in consequence of an injury which caused no shock nor alarm to the constitution, nor nervous irritation. Now I am quite satisfied the operations were as well done as they possibly could be; yet each operation, or something else, proved so great a shock to the constitution or system at large of the respective patients, as to destroy life in a short time; forcing us then to conclude, that a regular amputation, in which, comparatively speaking, little blood is lost, is capable of producing an effect which shall terminate the life of the patient in a very short time; whilst the amputation made by a cannon-shot, with a sudden or greater loss of blood, produces little or no effect at all. I do not apprehend this conclusion can be avoided: the cannon-shot either does produce an effect, or it does not. If it does produce an effect, it must be a shock to the whole system, and I am correct in what I have advanced. If it does not produce an effect, my inference is inevitable.

Viewed with reference to success, it will be found that the three great operations, one at the hip-joint and two of both thighs, were lost, so that haste does not appear to have been more beneficial in these cases

(and it was to such serious cases I alluded, and to which only the argument or principle is worth considering), than the delay I have advised when necessary. Upon the whole, if the success of Dr. Quarrier's practice, who says he amputated in all cases within half an hour, be compared with that of Dr. Dewar, who performed all his, with the exception of one, some hours afterwards, it will be found that Dr. Quarrier lost six out of fifteen, whilst Dr. Dewar lost only one out of seven. In stating this, I particularly deny that any conclusion can be formed from it: I am aware also, that good reasons may be given why the loss on board the Leander was so great, but all these reasons ought to have been taken into consideration when the statements were made relative to the wounded on board the Impregnable, the surgeon of which has been, in my opinion, most improperly censured, if not in direct terms, by implication not to be misunderstood. The whole question, however, requires to be viewed in a different way to what it has been usually considered: it is not possible to settle it in the closet so peremptorily as to form one general rule, when there are such a variety of exceptions constantly occurring, and, however positive any man may be in his preconceived opinion, I defy him to walk ten minutes among the wounded, after a great battle, without feeling that he is in error. There is in some cases as much difference between the effect produced on the system by a musket-ball through the elbow-joint, rendering amputation necessary, and that produced by a cannon-shot striking the upper part of the thigh, as there is between the effect of the simplest operation in surgery and that of amputation. There is, often, nearly as great a difference in the effect produced by a wound of the same kind in two persons from the difference of constitution.

I beg, finally, to observe, that my observations apply particularly to serious and not trifling wounds, to injuries of the thigh, not to those of the arm; and, in order to prevent any mistake in future as to my opinions, I will reduce them to the form of rules:

First, That if, after an injury, of whatever sort, there be few or no symptoms of shock and alarm to the constitution or system at large, the operation is to be performed forthwith.

Second, That if there be considerable shock and alarm to the system at large, from whatever cause, and the patient be in one or other of the states described page 164, first edition, and page 243 of the present, a certain delay and the exhibition of cordials is to be resorted to. In the other case, amputation is the only, although a doubtful remedy.

I appeal with confidence to the officers who served with me in the Peninsular army, to say whether or not this was the practice I invariably pursued. If any one is disposed to accuse me of doing one thing and of recommending another, I shall not consider him worthy of my attention, or that of any honourable man.

On the preceding observations, Mr. Hutchison, in 1826, made some remarks, the practical facts, observations, and arguments he has not replied to; they are indeed incontrovertible, if not indisputable. His principal object appears to be a desire of persuading the public into the belief, that I have been induced to change my opinions and practice in consequence of his remarks, and that he has the merit of first placing these subjects in a correct point of view. The reader will be pleased to observe,

1st. That when I published the first edition of my work, I was perfectly acquainted with the writings of the Baron Larrey, to whom I was also personally known, and whose opinions were printed and translated into English.

2dly. That Mr. Hutchison has not advanced one opinion, has not made one observation, nor recommended one point of practice, not previously directed by the Baron Larrey.

3dly. That Mr. Hutchison never was, I am informed, in action, so as to have the opportunity of seeing a person's thigh carried away by a cannon shot, nor of seeing him at any time *within half an hour* afterwards; and therefore, as to the great point in dispute, must be totally unacquainted (as far as personal observation extends) with the whole of that part of the subject on which he writes.

4thly. If Mr. Hutchison will show in what he differs from the Baron Larrey, I will immediately make every acknowledgment he pleases, and attribute to him as much originality as he demands; but until he does that, the only merit he can claim, according to my idea, is, that of being a strenuous supporter of Barron Larrey's opinions; and when he recommends to my attention the golden rule of "suum cuique," he surely cannot mean to say, under these circumstances, that he has any claim to originality which I have wilfully overlooked.

To the observation made on Staff-surgeon Williams I need only say, that gentleman's first operations in Portugal were done under my observation, on the march and at the attack on Oporto; that he served with me, and with the part of the army with me, and his remark applied to me with other persons.

In regard to Colonel Beckwith, I have merely to remark, that if this

officer has thought proper to make two different statements, it is no concern of mine: I can only assert, that the one I have printed is a correct one, as given to me by himself.

Those gentlemen who think an officer can have his ankle joint knocked to pieces by a grape shot without knowing it, will continue to remain of that opinion; others, who, like myself, have been wounded by a musket ball, and who are aware of the dead, heavy, painful blow caused by it, will believe in the version I have given of it.

In the first edition of my work, not doubting for a moment the propriety of amputating forthwith, in every case unattended by particular symptoms forbidding it, in which I agreed with Larrey, and presumed no military surgeon denied, I proceeded at once to urge those points in which we differed; and it is impossible the cases can be more strongly contrasted than in the way in which I have given them, pages 48 and 51 of the first, and 231 and 233 of this edition. If I had been a theoretical writer, I might have been charged with a change of opinion with some shadow of justice; but when I have shown by reference to my practice in almost every battle, from the first at Roliça to the last at Toulouse, that it accorded with the observations I made, and the doctrines I declared to be the guide of myself and the other army surgeons during the war, such a charge is shown to be without foundation, and to have originated in misapprehension.

Of Secondary Amputation.

Secondary amputations, or those performed from the third week to a later period of the continuance of any injury, are by no means performed by military surgeons with such confidence of success, as those done on the field of batle; or with such comparative success as the writings and opinions of surgeons in civil life, and the advocates for delayed operations seem to indicate. On the contrary, they are found to be attended with considerable danger, arising from a variety of causes, and to be followed frequently by greater evils than those operations performed on the field.

This difference of success between the surgeons engaged in domestic and in military surgery, may perhaps arise in some

degree from the nature of the service, which does not at all times admit of the same comforts and attendance as in private life; but the difference is still very remarkable, even amongst officers, who, with some exceptions, have every thing they require. In domestic surgery, amputation is very seldom performed, except in sound parts; in military surgery it is the reverse, and is seldom done, except in parts that have suffered in some degree from inflammation; and this is one of the many peculiarities attendant on gun-shot wounds, that renders the practice of the military surgeon more difficult, and his success more doubtful.

When secondary amputation is performed in parts nearly in a healthy state, where the extent of injury has not been great, the discharge moderate, the constitution of the patient naturally good, and every convenience attainable during the cure; it would, I believe, be accomplished nearly as successfully as when performed shortly after the injury; but nothing would be gained in safety to compensate for the misery, the anxiety, and the danger attendant on the delay.

Military surgeons meet with few cases of this kind; for, independently of those persons who die without operation, before they reach the proper period for secondary amputation, and those whose limbs are removed from necessity before this period; most of the operations are performed in parts that have been lately affected by inflammation, or are still in a state of irritation. In these cases the cellular membrane is firmer and more compact than usual, the muscles are not perfectly healthy, the blood-vessels of the soft parts are considerably larger and more numerous, they sometimes take on actions unusual to them in a state of health, and where the bone has been diseased, much bony matter is often deposited in the muscles; and in some cases, from the time of the operation until the death of the patient, a period of a very few days, I have found several of the ligatures completely surrounded and immovably fastened in bone. After a few hours'

remission, the constitutional irritation returns, and the increased size of the smaller blood-vessels renders secondary hæmorrhage much more frequent. The ligatures are a source of irritation, and prevent union, even if it were likely to take place; and in the best of these cases, a conical stump is in general the result, after much pain and anxiety.

After a great battle the wounded are usually collected in large hospitals. If these hospitals are not greatly thinned at the end of three or four weeks, no wounds do well, and the health of most of the men is affected by the air of the hospital; a fact that is constantly demonstrated by the amendment of those who are able to travel to a new station or establishment. Amputations performed in an hospital of this kind seldom do well; the febrile irritation remains after the operation, the wound suppurates, does not unite, the strength gradually decays, and the patient dies exhausted. The whole of this statement was exemplified in a very striking manner, in our hospitals, after the battle of Vittoria, properly so named; and a second time after the battle of the Pyrenees, near Pampeluna, when the same hospitals were necessarily a second time filled with wounded, many of whom required the greater operations of amputation.

At other times the wounds slough, and hæmorrhages take place, demanding other operations; or, in many cases, destroying the patients where assistance could not be given in time, or surgical aid could be of no avail; as where the axillary artery has been tied repeatedly after the operation at the shoulder-joint. From such causes most of the unfortunate cases in the statement of operations at the shoulder-joint, from June to December, 1813, terminated fatally.

If any endemic disease prevails at the time a soldier undergoes a secondary operation, and he is so unfortunate as to acquire it, as in the Peninsula, where intermittents, bilious remittents, and dysenteries were endemic in autumn, the season for military movements; or in Flanders, where inter-

mittent and bilious fevers prevail at the same period; or, when contagious typhus fever is prevalent, as in the greater part of our hospitals after the retreat from Burgos; he will frequently sink under the united pressure of the disease and the operation; whereas, the soldier who has had his limb taken off at the time of injury, has much greater powers of resistance in him, than the other who has been labouring three or four weeks under an incurable injury; and what is of more consequence, his stump is nearly healed before he becomes subject to disease, or is affected by the bad air of the hospital.

When, from any cause, an amputation is delayed to the secondary period, a joint is most frequently lost; for instance, if a leg be shattered four inches below the knee, it can frequently be taken off on the field of battle, and the joint saved. Three or four weeks afterwards, the joint will in all probability be so much concerned in the disease, that the operation must be performed in the thigh; or in the fore-arm, when the hand has been injured; and at the shoulder-joint, when the upper part of the humerus has been broken. The principal mischief resulting from this delay is where the injury is about the middle of the thigh; for amputation on the field, near to the seat of injury, is performed with a fair prospect of success; but, at a later period, it must be done at the little trochanter, or at the hip-joint, and the chance of success will be much diminished. This is a very important point for the consideration of surgeons, who recommend delay in doubtful cases; as well as the fact, that amputations in unsound parts are frequently fatal, and are always attended with danger.

In gun-shot wounds of the thigh, with fracture, there is little possibility of cutting into sound parts if the injury be high up, and yet hæmorrhage will frequently require it to be done. Whilst waiting the proper period for amputation, in a case of fracture, I have seen both the femoral artery and vein opened

into by ulceration, or by a projecting point of bone, injecting the limb with blood, and rendering immediate amputation necessary; which will not in general be successful. It must not also be overlooked, that these evils occur while the patient is waiting the proper time for amputation; and that they would have been avoided, if it had been done in the first instance.

I have said, page 253, that secondary amputation in favourable cases is nearly as successful as primary; that is, the wound would heal as soon; but the difference of success in favour of the primary operation arises from there being less danger of any local affection after it, than there is after a secondary operation.

After secondary amputations, where there has been a great discharge, amounting perhaps to near a pint of pus at each dressing, as in cases of compound fractures, wounds of the knee-joint, &c. the constitutional affection often becomes severe a few hours after the operation, or perhaps in the course of two or three days; there is considerable fever, and occasionally a sudden determination to particular parts, which very soon ends in death. As I have not seen this after primary operations, I believe it to arise from the system being unable to accommodate itself to the sudden change so well, as when the person was in a state of health: for, although the continuance of the discharge would very soon have destroyed the patient, still he is not able to bear the sudden change on the removal of the limb; because, the quantity of blood sent to it for the formation of pus and the natural supply of the limb, was much greater in proportion to the quantity in circulation, than in a state of health.

In adopting this opinion of the adversaries of operations performed on the field of battle, I apply it in opposition to the manner in which they intended it; and it is probable they will think, that if it was not valid in the one case, it is not in the other; and this may be true, but I leave them to account for it, while I relate a fact well known to every military sur-

geon of experience: that forty-eight hours after amputation above the knee, in two cases, one performed on the field of battle, the other at the end of three or four weeks, in which there had been great discharge, and both dressed in the same way with the view of procuring union; he would have much more anxiety for the secondary than the primary operation, and it would require a much more attentive general treatment.

In the particular cases to which I allude, the febrile irritation increases some time after the operation, instead of gradually abating; and after a continuance of a few days, or in some hours, cuts off the patient by an affection of some particular part. If it be the lungs, and they are most usually affected, the breathing becomes uneasy, there is little pain when the disease is compared with pneumonia or pleuritis, the cough is dry and not very troublesome, the pulse having previously been frequent there is but little alteration, the attention of the surgeon is not sufficiently attracted by the symptoms to the state of this organ, and in a very short time all the symptoms are deteriorated; blisters are employed, perhaps blood-letting, but generally in vain; and the patient dies in a few hours as in the last stage of inflammation of the lungs, in which effusion or suppuration has taken place.

The first cases I saw of this kind, I believed to arise from the action of external causes after the operation; but I now believe it to depend upon a determination to, or irritation in, a particular part, in consequence of the operation; and I conceive the viscera in each person most predisposed to disease, will be the most likely to be affected.

When the inflammation attacks the lungs, the approaches of it are very insidious; the soldier does not suffer sufficient to make him apply for particular assistance, as he labours under fever; and when the disease has advanced to that point that the attention is especially drawn to it, the time for assistance is past, and the disease shortly proves fatal; in some instances apparently by suffocation. The lungs on dissection are found full of blood, and firmer than usual, occasionally pus

is formed in them, or there is effusion into the air-cells, and into the cavity of the chest.

This sudden and insidious attack of disease was observed by several officers during the Peninsular war; and I am certain that many cases are lost without much particular observation; for, in those that have been noticed, the disease appeared to have existed for so short a time, as almost to have excluded the suspicion of its being the cause of death, and yet there has been pus found in the lungs, and in the cavity of the chest. My own attention was drawn to it after losing several cases in this way, as a circumstance of more than common accident, from its having happened in a young man to whom I was paying considerable attention; since that, I have had one well-marked case at Santander, of a sudden and fatal affection of the lungs after amputation of the thigh, under the immediate care of Dr. Irwin, Physician to the Forces; and Sir James M'Grigor did me the favour to transmit me the account of a case of the same kind, that occurred to Mr. Rose of the Guards, after amputation of the arm.

My friend Mr. Boutflower, Surgeon to the Forces, whose experience, during the Peninsular war, was very great, has informed me, that in consequence of losing several amputations, without any satisfactory assignable cause, he was induced to attend particularly to the examination of their bodies after death; and in two cases of this kind, which terminated fatally at Fuenterabia, after amputation of the upper extremity, he found a considerable quantity of pus in the cavity of the thorax, and other general marks of inflammation. In these two cases, so insidious was the approach of this disease, that except a difficulty of breathing, which supervened a few hours before death, there were no symptoms indicating the existence of such morbid affection. In both, there was much febrile irritation, with occasional and severe rigors; but the entire absence of pain led to the belief, that these were referrible to the formation of matter in, or about the stump. In consequence of this unexpected occurrence, Mr. Boutflower made

it a practice to bleed in every subsequent case, where there was any undue febrile irritation, and with the happiest effect.

When the viscus affected is not so immediately concerned in supporting life as the lungs, I do not believe the termination is so rapid; it runs into suppuration, and abscesses are formed, which are generally supposed to arise from the commotion and shock given to the different organs, at the moment of injury. I have not seen the heart affected with inflammation in the same manner, but I suspect it is likely to occur in soldiers who have been hard drinkers; for in them I have frequently seen it, after an attack of inflammatory fever, destroy the patient, when there was no suspicion of its being the organ originally affected.

I know that inflammation taking place in one part of the body, when the injury has been received in another, has been often noticed; and that this also happens in gun-shot wounds there can be no doubt, but it is by no means a common occurrence. M. Larrey, in his first volume, page 306, gives a case after primary amputation, in a general officer, who was wounded at the siege of Acre by a musket-ball, which passed through the elbow-joint, destroying the articulating surfaces, and doing so much mischief as to render amputation necessary, which was immediately performed. The shock of the blow and the fall of this officer, which were simultaneous, caused considerable disorder in the limb, and in the viscera of the thorax and abdomen. He appeared to be doing extremely well until the thirteenth day, when he was attacked by all the symptoms of a nervous fever, with exacerbations, which were attributed to the chilliness and dampness of the nights, the unhealthiness of the camp, and other causes foreign to the operation. The stump was in a good state, and had nearly healed, but there was no discharge from it. The febrile symptoms, however, rapidly increased, and on the nineteenth day he died. On opening the body, an abscess was found in the liver, and another in the lungs, with effusion in the chest. In this case M. Larrey thinks the predisposition for the inter-

nal disease was caused by the commotion which took place at the time of the injury, and from the bilious idiosyncrasy of the patient.

I conceive the following case to be an instance of it in the thyroid gland. A soldier had his thigh amputated by Dr. Chermside, 10th hussars, five weeks after the injury, in consequence of a compound fracture of the thigh when in a very reduced state, the discharge from which was profuse, the pain great, and the hectic fever severe. He sunk a good deal after the operation, the stomach became very irritable, and small doses of brandy and water could alone be retained, the pulse being small and frequent, the countenance pallid and contracted. He remained nearly in this state until the third day after the operation, when he complained of difficulty in swallowing, and a little pain in the situation of the thyroid gland, which the next morning was found to be swelled and inflamed. The linimentum ammoniæ was used to the sides of the throat, and subsequently blisters; gentle diaphoretics were given internally, his bowels kept open by the oleum ricini, and his throat cleared with the common acid gargle, although little or no inflammation was apparent; his diet was of milk and beef tea, the prostration of strength being very great. On the third day after the affection of the throat, the difficulty in deglutition increased, accompanied by some obstruction in respiration, and on the morning of the fourth he died in a state of great emaciation, seven days after the operation. On dissection, the whole substance of the thyroid gland was destroyed, and good pus deposited in its place, which descended by the sides of the trachea and œsophagus to the sternum, and had all but found its way into the larynx between the cricoid and thyroid cartilages on the right side. The surrounding parts were but slightly injured, and could be readily dissected.

The following instance will show a deposition of pus with little or no attendant inflammation, and is a good case, as fairly illustrating the manner in which one half of the fatal

cases of secondary amputation die, when there is any particular irritation in the stump.

Daniel Lynch, 36th regiment, was admitted into the Calvete General Hospital, April 12th, 1814, in consequence of a gunshot wound penetrating the knee-joint, received on the 10th of April, in the action before Toulouse.

Notwithstanding frequent general and local bleeding, and the strictest antiphlogistic regimen, with the application of cold to the part, high inflammation of the joint ensued. On the 8th of May the limb was removed. His health before the operation was not good, being constantly under the influence of irritative fever, and his strength very much reduced by it, and the profuse discharge. The night succeeding the operation he passed comfortably; on the 9th, the febrile symptoms increased, and the bowels being in a state of torpor, small doses of the sulphate of magnesia, with infusion of senna, were administered, which succeeded in procuring several bilious evacuations; a saline anodyne draught was given him at night. On the morning of the 10th, he was considerably worse; pulse 150, skin hot, tongue parched, with excessive thirst, stomach irritable; he was ordered a saline draught in a state of effervescence every three hours, and was also directed to be frequently sponged with vinegar and water: this treatment was steadily pursued during the day and succeeding night. On the 11th he was evidently better, and continued gradually to amend; on the 16th he was considered in a state of convalescence, and remained apparently going on well until the 22d, when he was again seized with symptoms of fever, which however continued mild until the 26th. On that day his stomach again became irritable; but this was relieved by the repetition of the effervescing draughts. At this time the stump was nearly healed throughout its whole extent, but only two of the ligatures had as yet come away; the discharge was small in quantity, but of a good quality. On the 30th, he had had no return of the vomiting, but his pulse had risen from 100 to 110, and his tongue had assumed a brownish hue. During

the 31st and 1st of June he got worse; camphor, æther, bark, wine, &c. were administered, but in vain. On examination, the stump appeared externally to have united, except where the ligature came out; on cutting through the line of adherence, which consisted only of the common integuments, the face of the muscles was discovered of an unhealthy sloughy appearance; the bone for about three inches was surrounded by a case of osseous matter, diffused widely among the contiguous muscles, and including the remaining ligature, which could not be removed by any force not breaking it; the femur, for the space in which it was enclosed, was bare, and showed marked signs of absorption.

Having dissected the left extremity for other purposes, which appeared perfectly sound, and of which he had never complained, for considerable attention was paid to him, I found, on raising the soleus muscle, a membranous bag, containing a fluid in the course of the tibialis posticus muscle, and close to the interosseous ligament. I punctured this shining semi-transparent bag, which appeared to be the fascia running across, and let out between three and four ounces of good, thick, yellow, inoffensive pus. The blood in the peroneal vein, which was close to the outside of the sac, was coagulated, or rather, a coagulum had formed in it prior to death: there was no perceptible cause of injury, and little or no marks of inflammation; it would indeed give the idea of having been deposited without any. The inner side of the soleus seemed simply discoloured, where it covered the bag; the outside, and the integuments, were quite in a natural state.

I am disposed to think this matter was secreted, or deposited, after the amputation, which was performed high up in the thigh, yet the bone was affected by necrosis, and three inches of it at least must have come away if the man had lived.

I am not aware that this sudden and insidious attack of disease has been noticed hitherto as a disadvantage attending in particular secondary operations; and in thus mention-

ing it, I am desirous of drawing the attention of surgeons to it, and of gaining further information on the subject; for, as already stated, I have reason to believe many cases are lost in this way, without the cause of death being ascertained by dissection.

In the foregoing observations on secondary amputation, in the first edition of this work, I believe I drew the attention of the profession, for the first time, to a cause of death after amputation, which is by no means unfrequent. I allude to a sudden and insidious affection of particular parts, and especially the lungs, by which the patient is speedily cut off; and I stated, that, as far as my observation extended, it had not occurred after primary, or certainly not in the same proportion as after secondary amputation; which induced me to suppose it depended upon a determination to, or irritation in a particular part, in consequence of the operation; and that the viscera in each person most predisposed to disease would be the most likely to be affected. In support of this opinion, I gave the heads of several cases, pointed out the necessity of vigorous measures on the first appearance of the disease, mentioned the appearances on dissection, and inculcated the necessity of soothing applications to the stump, instead of a continuance of the means usually adopted to enforce union. Later observation, after the battle of Waterloo, and in the clinical wards in the York Hospital, under my direction, as well as the communication of my friends, induce me to believe that the foregoing opinions advanced were on every point correct; that the facts are important, I am glad to find acknowledged; that they are useful, I am disposed to believe, as they have found their way into other works, but they have yet been partly misunderstood. The object I had in view was, not to show how far a continuance of habitual fever would in time affect the viscera, how far an increase of this fever suddenly excited might hasten this affection; I had no such intention, because inflammation and suppuration of the lungs draining and destroying a patient after hectic fever, the consequence of a disease the

constitution could not overcome, are, and have so long been known to all authors and practitioners, that it would have been a matter of supererogation to draw their attention to it. That fever, of any kind, when of long continuance, tends to the disorganization of particular parts, and that this tendency is still greater in warmer climates than in our own, are facts equally well known to every one acquainted with the practice of medicine. That where a disease, or a predisposition for it, exists in an organ, any increase of general excitement, constituting fever, always tends to increase the evil, is so well known, that no student acquainted with the first rudiments of the science can be ignorant of it. That the symptoms I enumerated, the affection I ascertained, might, in some cases, depend on one or all these causes, all were aware of; but the particular kind of disease I alluded to appeared to me not to depend, for the most part, on any of them, further than that the constitution or system at large must in all be more or less affected by every general cause of disease.

The circumstance of persons, for the most part, being affected, who previously to the amputation had laboured under considerable pain and an excessive discharge; whilst those who suffered amputation without enduring such previous state of disease generally escaped; induced me to believe they in some measure indirectly contributed to its occurrence. When I observed, that those who did not suffer to the same extent from a profuse discharge, and in whom amputation was delayed, were not affected in the same manner; that it did not occur in the same proportion in those who were equally suffering from habitual irritation, but not exposed to so great a drain; and when I saw that it occurred in cases where there was no reason to suspect disease of a particular organ,—I was confirmed in the inference I had drawn. When I reflected, that in the greater number of cases in which the hectic fever threatened disease of the lungs, in consequence of incurable disease of the knee-joint, amputation acted like a charm, and snatched the patient from the impending danger; when I

considered that it did so in many cases of the same description, even where there was an excessive discharge; when I considered the analogy discoverable in many other diseases; when I reflected on the suppression of a long-continued hæmorrhoidal discharge, often producing apoplexy, or disease in the lungs or liver, at a certain interval of time; when I reflected on the same kind of thing occurring after the cure of old fistulæ by the knife; I was satisfied that the more probable theory might be founded on the alteration which took place in the sanguiferous system, in consequence of the amputation and the suppression of the discharge causing fever, and a determination to, and irritation in a particular part, rather than to the stimulus of the knife causing this excitement. The opinion which Mr. C. Bell has advanced on the subject, is a distinction without a difference, for the effect I have insisted upon, *viz.* an increase of fever, with a determination to, or irritation in a particular part, is acknowledged; the practice recommended is not disputed, or a new point or observation added. In fact, whoever reads my book, from page 75 to 83, published in 1815, and Mr. Bell's in 1817, will immediately perceive that the facts and observations of the one are those of the other, and that Mr. Bell was sadly forgetful when he wrote, "it is one of the many subjects authors have neglected to treat of," or when he proceeded to show "how much the subject had been overlooked in the matter of amputation." Indeed he has entirely mis-stated my opinions, whilst he has adopted the conclusions as his own. I have particularly said, that this attack on the lungs, or other of the viscera, did not commonly follow amputation on the field of battle, and the reason is, that the persons suffering these operations are generally in good health, and capable of sustaining and overcoming any alteration which may take place in the system; whilst those who are reduced by disease, and *accustomed to a profuse discharge*, are rendered highly irritable by the continuance of both, and predisposed, in consequence, to irritative fever on the application of an exciting cause. A state

of fever ensues, soon followed by an inflammation of a particular part, which is generally that which is most predisposed to disease, and therefore, in Great Britain and among Englishmen, the lungs are most commonly affected.

If the disease had been merely an inflammatory attack on the chest, with the usual symptoms of pneumonia, it would not have required any elucidation. It was a disease not characterized by the usual and most prominent symptoms of inflammation of the chest that I particularly noticed, and without the usual symptoms of inflammatory fever; for, on the contrary, that which accompanies it, usually bears the type of any fever endemic of the country at the time, whether it be intermittent or typhus, and the true symptoms of disease of the chest are detected only when too late. That a disease of this kind may occur without any wound whatever, I very well know; for, after the retreat of the army from Madrid and Salamanca, a fever of a low kind appeared in the second division of the army, shortly followed by an inflammatory affection of the chest of so obscure a nature, that dissection alone pointed out its constancy in every fatal case; and although symptoms appeared to forbid venesection, dissection demonstrated the necessity for it; and the success which followed, attested its efficacy at the commencement of the attack, even if the symptoms did not seem absolutely to require it. Of a disease of this nature with a wound, the following is an example.

John Hodges, 3d Guards, æt. 21, was wounded on the 18th of June by a musket-ball, which entered a little below the anterior part of the right shoulder, passing out behind; it went on favourably till the 15th of July, both wounds having a healthy appearance, and discharging good pus, when the arm became tumid and painful; he had rigors and other symptoms denoting the formation of matter, but it did not reach the surface till the 21st, when it was opened, and a very large quantity of offensive pus was evacuated. During the period specified, he constantly laboured under more or less fever, with

slight cough and expectoration, for which he took saline purgatives and febrifuge medicines. At the time of opening the abscess, the fever was much abated, and what little he had was of a low type. 24th. Passed a very restless night, and, for a few hours, was delirious; complains of pain in the chest, and expectorates a considerable quantity of purulent sanguineous matter; pulse quick; but notwithstanding he was very low six or eight ounces of blood were drawn from the arm. 25th. He passed another restless night, but his pains and fever were much abated; blood drawn yesterday did not exhibit the inflammatory appearance; expectorates freely; the discharge from the abscess continues very offensive, and the original wounds have assumed an unhealthy appearance. A pectoral mixture was ordered, and acidulated barley-water prescribed him for common drink. 26th. He had little or no fever; expectoration diminished, and no pain whatever in the chest; he was however extremely low. Wine and sago and a pint of milk were ordered him. In the evening he was somewhat sunk—Applicetur sterno empl. lyttæ. About 11 P. M. there was a discharge of blood from the abscess, to the quantity of about half a pint, from the effect of which he never rallied. He died at three o'clock on the morning of the 27th.

Appearances on Dissection.

The ball was found to have passed completely through the spongy part of the os humeri, below its head; the muscles on the outside of the arm were greatly disorganized, and the whole arm above the elbow was nearly in a state of mortification; it was impossible to discover from whence the hæmorrhage came, but in all probability it was from one of the articular arteries.

On examining the thorax, a large quantity of serous fluid was discovered in both sides; the pleura was covered with a layer of purulent matter, the air-cells of the right lung (the affected side) were filled with pus; and on the external surface were observed many small tubercles. The left lung

was much inflamed, but no pus could be observed in its substance.

The following case, for which I am indebted to Dr. Gordon, is a good example of translation of disease from general irritation, and of the impossibility of following nature in all her proceedings: but it must be observed, that an incurable disease existed from the first, which no operation could relieve, although it might increase.

Michael Abernethy, first battalion 7th regiment, was transferred, on the 1st of January, from the first to the second division of St. Louis' Hospital, with an abscess a little above the left knee-joint, in a depending situation. There was considerable swelling and inflammation without any determined edges. The swelling extended all the way up the thigh as far as the pubes, and downwards to the leg and foot, which were œdematous. The knee-joint was much swollen; and there he complained principally of pain. Fluctuation was very obvious all round the joint, and to some extent above it. His health was very much impaired, and he was becoming hectic, pulse 150, and very feeble, tongue white and parched, skin hot, bowels regular. A free opening was made into the abscess, when upwards of three pints of fluid were discharged. The first pint and a half was principally serum, mixed with a small quantity of blood; it was ichorous, and as if coming from a carious bone; it gradually became thicker, till at last pus was discharged, with an oily matter floating on the surface of it. The thigh was well fomented, and afterwards enveloped in a large poultice, which was frequently renewed. A bandage was then applied moderately tight from the top of the thigh as far as the incision, and another from the toes to the knee. The bandages were kept constantly wet with the camphorated spirit of wine: bark with sulphuric acid were ordered every three hours; a grain and a half of opium twice a day, a quart of wine and two gills of brandy daily, with low diet, eggs, rice, and milk.

2d. Feels himself easier — There has been very little

discharge since last report—Passed a restless night, and coughed a great deal—The swelling of the thigh and leg very much reduced, and the fluctuation, which had existed about the joint, gone—Pulse 130, rather fuller, bowels costive, tongue white.

3d. Has a hectic look, and perspired a great deal during the night—Thigh and leg of the natural size, but foot much swelled—Rather more discharge from the wound than yesterday—The wound itself has an unhealthy appearance, and the discharge fetid—Last night his respiration was very laborious, and, upon examination to-day, a large tumour was discovered in the course of the pectoral muscles, extending from near the nipple to the axilla and scapula—He complained of great pain shooting along it to the top of the shoulder, particularly upon the slightest pressure—There was an evident fluctuation, and, on making a small incision into it with a lancet, a quantity of matter was evacuated, much of the same nature as that which was discharged from the thigh—It was well fomented—A compress applied in the direction of the sinus towards the scapula, and a small poultice was laid over the opening—Pulse 130, and extremely weak.

4th. Better in every respect—His breathing is easy, and he feels no pain in the breast—There is an indurated circumscribed swelling round the wound—Very little discharge from the thigh, the swelling of which is entirely reduced—Slept very well—Perspired much—Pulse 105, and fuller—Tongue clean—Bowels open—Has a hectic flush at present—Urine very high coloured—Medicines continued.

5th. Slept well last night, and feels easier to-day—Did not perspire so much—Discharge from the breast more considerable, and fetid—The matter comes entirely from above, from a sinus extending towards the scapula, and is evacuated only by a firm degree of pressure—Respiration is now become free, and the cough very trifling—Wound of the thigh sloughing.

6th. Had a pretty good night, and feels no pain whatever —Perspired a great deal—Discharge from the breast of an unhealthy nature—A small slough thrown off from the thigh—Pulse 100, and weak—Bowels open. Continuentur remedia omnia—Habeat quoque pulv. cinchon. ʒss 2da quaque hora.

7th. Had considerable diarrhœa all last night—No griping —Great prostration of strength—Discharge from the breast more considerable, and from the thigh very copious, but of a more healthy nature—Pulse quick, and weak—Tongue furred—Died at night.

N. B. This man was admitted with acute rheumatism marked upon his card; it was some time before it was definitively settled that an abscess was forming; during the intermediate time, about ten days, he took saline and diaphoretic medicines, and fomentations to the part, occasionally stimulating embrocations. He never complained of any pain in the chest that could at all indicate the formation of an abscess, although he sometimes mentioned a tightness across his chest, attributed, at the time, to catarrh, many symptoms of which he had at his entrance into the hospital. The period between the opening of the abscess in the knee, and his first complaint of the tumour in his breast, was about thirty-six hours. There was an erysipelatous blush round the base of this tumour, it pitted on pressure.

Dissection.

It proves to be *necrosis* of the femur. The abscess in the chest extended a little way below the pectoral muscle and clavicle, but had no connection with any of the bones; there were found several calcareous concretions in the lung of the left side, which was adhering to the pleura costalis, or showed marks of chronic inflammatory action. The back part of the lower end of the femur was entirely denuded of periosteum to a considerable extent, but not the condyles; the matter had not penetrated the joint of the knee: on the rest of the bone over its whole surface, in lieu of periosteum there was

a thick layer of pulpy matter, smooth, and of a red colour, which, when cut into, was found to contain callous or ossific matter; it firmly adhered to the bone: the *upper* abscess had a communication with the hip-joint.

The following case, by Mr. Boutflower, will illustrate more fully my meaning in regard to the nature of this disease when accompanied by fever of the typhoid type.

John Lomax, of the Guards, was admitted into the general hospital at Colchester, on the 27th of August. It appears he was wounded at the battle of Waterloo, and in consequence suffered amputation of the right arm on the 23d of August; the operation was performed midway between the shoulder and elbow joints. On his admission he was in a state of high fever of the typhoid type, and was unable to give any very distinct account of himself; he stated, that in hospital at Antwerp he had the ague for many days, which left him for a short time, but returned again on his passage on board ship to this country; that on the 25th he was attacked with pain in the side, which was very severe on the 26th, on which day a blister was applied to the affected part, which greatly relieved him. The stump had an unhealthy appearance, and evinced a disposition to separate. On the 28th he was free from pain; but his febrile symptoms were not abated, and there was a tendency to delirium. He continued with little alteration on the 29th, but sunk rapidly on the 30th, notwithstanding the use of the most powerful stimuli, and died on the evening of the 31st.

Appearances on Dissection.

A quantity of serum mixed with pus was found on the left side of the thorax; the pleura pulmonalis, on both sides, was covered with a thick layer of coagulable lymph; the pericardium was distended with fluid.

The liver was found enormously enlarged, pushing up the diaphragm, and completely displacing the lungs on the right side: in its substance a large abscess was discovered

containing at least a quart of pus. The stump did not exhibit any peculiar appearance.

I have said, that when an endemic disease prevailed (page 252), the symptomatic fever which ensued would frequently assume the same form, and there never was, perhaps, a better illustration of this, than in the difference of disease in the hospitals of Brussels and those of Antwerp. The soldiers in both were, in many instances, of the same regiments, and in all things, previously to their admission into the hospitals, precisely under the same circumstances. Yet at Antwerp the type of fever was generally intermittent, becoming continued, and even of the typhoid form when accompanied with local inflammation; whilst at Brussels it maintained its usual character.

The following case, transmitted to me by Dr. Higgins, Deputy Inspector of Hospitals, and principal medical officer at Antwerp, I have transcribed at length, because it shows the nature and symptoms of the disease prevalent there, and the appearances on dissection, which were very nearly alike in all those who died after operation.

A soldier of the 92d regiment, forty years of age, was wounded by two musket-balls in the right hand and wrist, on the 25th of June. On the 5th of July the arm was swollen above the elbow, the hand œdematous, the discharge profuse and fetid, countenance sallow and dejected, the skin hot, bowels confined, tongue loaded, pulse ninety. 6th. The bowels opened by medicine, tongue cleaner, skin cool, pulse eighty, wound discharges profusely, patient much debilitated. 8th. The arm amputated above the elbow. (The whole fore-arm lost in consequence of the operation having been delayed, and the extent of the swelling and inflammation which ensued.) 9th, 10th, and 11th. A little increase of fever, the bowels being kept open, and saline medicines administered. 12th. Had a paroxysm of intermittent fever, which he has been subject to since the expedition to Walcheren. On removing the dressing, the edges of the stump were retorted, the discharge copious

and fetid, respiration hurried, complains of thirst, skin hot, pulse 90, skin tinged of a yellowish colour. 14th. Had a return of the paroxysm this morning, respiration still hurried, pulse 95, bowels open, head affected in consequence of the long continuance of the hot fit. Stump very irritable, and discharging profusely. Calomel and antimonial powder were given every three hours, and saline draughts; the bowels kept open. 15th. Complains to-day of fulness and pain in the left side, pulse 100, skin tinged of a deeper colour, a sense of suffocation in the horizontal position. A blister was applied to the whole of the left side. 16th. The blister rose well, but did not relieve the pain in the side. Was delirious during the night, vomited frequently, and about the usual period of the attack of the intermittent he became insensible, and died in the evening.

Dissection.

On opening the chest, the lungs were found to adhere to the pleura costalis in several places, had lost their usual spongy texture, and were dense like liver; a quantity of serum and coagulable lymph was contained in the left side, sufficient to prevent the dilatation of the lung, in which a small abscess had also formed. The viscera of the abdomen were sound, with the exception of the liver, which was enlarged to twice its usual size.

Dr. Hennen, page 272 of his valuable work on Military Surgery, has related the particulars of a case which was communicated to him by Staff-surgeon Hughes, of an abscess of the liver taking place nine days after secondary amputation of the thigh, and destroying the patient on the fourth day from the appearance of the attack.

On the Operation of Amputation.

There is a great difference in the manner of performing primary and secondary operations in military surgery, arising from the parts divided being in the one case sound, in the

other frequently the reverse. There is no less difference in the method of cure. In the one it is to be expected in great part by adhesion, whilst in the other, where the parts are not sound, it is seldom effected, but by suppuration and granulation; and the attempt to alter this course of nature by the interference of surgical art, is always very painful, is often the cause of much mischief, and frequently of death.

In primary amputations, or in the natural state of parts, the loose attachment of the cellular membrane to the fascia, and to the muscles beneath, admits of much retraction of the integuments; and when the first incision is made through the fascia, they retract considerably; which is greatly increased if the assistant grasps the limb with both hands previously to the incision being made, and pulls the integuments as much upwards as possible, putting the skin to be divided on the stretch, and rendering its division more easy to the surgeon, and less painful to the patient. If the limb be also firmly grasped below, and the integuments made tense downwards, the division of the skin will be more readily effected, and so much of the integuments will be saved in consequence of the retraction upwards, that it will not be necessary to dissect them back in the manner recommended in many surgical works. It will be sufficient to separate the threads of fascia adhering below with the point of the same knife, to obtain an ample covering for the stump, without putting the patient to the torture of having his skin pinched, and dissected back for the space of a couple of inches, and for four or five minutes. Bromfield and Allanson inveigh against this practice; and military surgeons during the last war proved it to be so unnecessary, that it is now acknowledged in general to be so by those who formerly recommended it; but in the adoption of it, they do not at all seem to be aware, that the fascia and integuments should be divided by the same incision, when the whole will retract much further than the skin and cellular membrane could do, if the fascia remained to be divided by the second incision. I

consider this simple direction to be of great importance, in the saving of time and pain to the patient, whilst it adds to the facility with which the operation is accomplished, and prevents the lodgment of matter between the skin and the muscles, which frequently occurs in the usual method of doing this part of the operation.

In operations performed from the third to the twelfth day, in parts at a little distance from the injury, this retraction will not always take place to a sufficient extent, either naturally, or by the force of an assistant, from the quantity of coagulable lymph thrown out; it will in these cases be necessary to separate it to a greater distance from the parts beneath, without however turning it back, as is usually recommended, like the top of a glove. It will also be frequently advisable to dissect out some of the jelly-like substance that fills the cellular membrane underneath, if union be desired.

In secondary amputations (with the exception of those in which the operation is required in parts actually unsound), the integuments will retract sufficiently by the means proposed; the lymph thrown out during the active inflammation having been absorbed, and the integuments being more in their natural state.

In cases in which there is great debility, and the loss of blood is to be feared, Brünninghausen recommends that a bandage be applied to the extremity to be removed, so as to press the blood on from the veins, previously to the incisions being made; and if this be done after the compression has been made on the artery by the thumb, it may be serviceable, provided the patient can bear the pressure. If the tourniquet has been applied, it will be of little use, and in very few cases should it be resorted to*.

It is usually allowed, that the appearance of the stump, when the bone is sawed through, should be that of a broad inverted cone, the bone forming the apex, but well de-

* Brünninghausen, Erfahrungen und Bemerhungen über die Amputation, p. 67, Bamberg 1818.

pressed. To effect this, the muscles must be cut through at unequal lengths, to allow of the greater retraction of those not attached to the bone. I consider this may be duly accomplished, in general, by two circular incisions, even in the thigh; one dividing the loose muscles running to be inserted in the bones below, with such part of those attached to the bone as cannot be avoided; the other, those having their attachment at the place of division. If the first incision leave any of the long muscles undivided, they may be completely cut through by a touch of the knife, and those that cannot retract are to be divided close to the edges of those that are retracted, by the next circular incision, which should be, if possible, down to the bone*. If the bone were to be now sawed off, it would not be well covered by the muscles; neither would it form a cone with the apex depressed or elongated: it is necessary therefore to dissect back the muscles adhering to it for the space of *from two to three* inches, as the size of the limb or other circumstances may require; and in doing this a large scalpel will be the most useful.

In secondary operations, it is necessary to leave more muscle than in primary ones, or, in other words, to cut the bone shorter; for the muscles on the under-part, if in the thigh, will retract and diminish much more than is frequently supposed; so much indeed, as to induce some surgeons to cut through them first by a semicircular incision, and allow for their retraction on dividing the others afterwards; but this is not necessary.

In secondary amputations, where there has been much suppuration in the limb, a sinus may run up, unknown to the surgeon, and a stream of matter follow the knife. In these cases, if the sinus extends only a short way between the

* I have omitted the direction usually given to incline the edge of the knife upwards, so as to make an incision slanting inwards; because it is never done when attempted, and if it could be done, is not necessary for the formation of a good stump. See the observations on this subject "On Amputation of the Thigh."

muscles, the membrane lining it may be dissected out, or it may be left without much disadvantage; but if the matter has lain upon the bone, it will have become diseased; necrosis, and a train of constitutional symptoms, will be the consequence, frequently terminating in death. In these cases, the amputation should be immediately begun higher up, at such distance as will include the diseased portion of bone, whether it be in the upper or lower extremity.

The muscles, having been divided and separated from the bone or bones as far as may be deemed necessary, are to be kept back at the proper place for the division of the bones, by a retractor of linen or leather, or any instrument that will allow the free motion of the saw without injuring the muscles. Where there has been much inflammation, or the limb is very large, there is some little difficulty in effecting this, and instruments have been invented to close on the bone, and push the integuments back. In the numerous amputations I have performed, I never found any difficulty not easily surmounted by the linen retractor in common use, aided by the hands of an assistant; and as it admits of pressure or retraction being made on any part desired, without much pain to the patient, or injury to the muscles, I prefer it to any thing I have yet seen for the purpose.

Before the bones are sawed, the periosteum should be cut through, without scraping it either upwards or downwards, as this practice is not only unnecessary but detrimental; for, when a portion of the bone is scraped, the saw is frequently placed in the middle, and the bone above being thus denuded of its natural covering exfoliates, delaying the cure, and causing a bad stump. It is true, that this does not invariably follow, as cause and effect, but it so frequently takes place as to be almost a constant effect of such proceeding; and the caution to avoid it, although the fact was known to both Petit and Richter, I consider one as important as any in this book, because it was not attended to previously, in the manner in which it ought to have been.

If the saw be applied to the edge of the periosteum above, there is no necessity to scrape it below, as it is going to be removed; indeed I have often sawed through the bone without previously touching the periosteum, and the stumps have been as soon healed, and with as little inconvenience, as any others.

In sawing bones, a saw is to be selected of a large size, that cuts with both edges, backwards and forwards, which expedites the operation, and, what is of more consequence, helps to prevent splintering when the bone is nearly divided; as the forward motion is more forcible than the backward, with which the operation generally terminates when the saw will cut in both directions. The saw should be as thick, or thicker at its edge than in the blade, or it will be confined in its own track. The limb, above and below, should be held steady, and perfectly horizontal. The saw should be used, not with short strokes backwards and forwards, but with a long and steady motion for nearly its whole length, placing the heel first on the bone, and drawing it upwards. The point should incline downwards; and when the bone is two-thirds divided, the saw should gradually be used more lightly, so as to cut the last portion without splintering; which will also in a great measure be prevented, by the assistants holding the limb steadily, and rather a little raised, so as to take its weight off the bone, and yet not impede the motion of the saw, which should now be inclined downwards nearly to a perpendicular; whereby the under part of the bone is cut through, and the side next the operator reserved to the last—a method of using the saw, which if it be adopted without any deviation, can hardly fail of dividing the bone in the most desirable manner, whilst it is frequently splintered, when done in the way usually recommended.

The arteries of a limb are next to be tied with round ligatures made of silk waxed, two threads being sufficient for the large arteries, and one for the smaller ones, or three threads for the femoral artery at the groin; not that the action of the

vessel would burst the ligature, but the force generally employed in drawing it on so large a vessel, will weaken it very much if it be not sufficiently strong. The great object of the ligature is to retain the sides of the artery as nearly as possible in apposition; it should therefore be pulled out by a tenaculum that will readily pierce its coats. The ligature is to be carried noosed on the tenaculum, and when the artery is separated from its accompanying vein, nerve, and cellular membrane, the noose is to be put over it and firmly tied; a second knot being made for security on the principal arteries, and a double noose or surgeon's knot made by putting the thread round the first knot a second time, for the smaller arteries. The nerve is always to be separated from the artery by the scalpel, if it cannot be done by easier means.

In primary amputations there are in general but few arteries that require the ligature; in secondary amputations there will be twice or thrice as many, making a difference in the period of time required for the operation, that is occasionally distressing, and is sometimes fatal.

The principal artery of a limb can in most cases be readily distinguished and secured, without slackening the tourniquet, or raising the compress, where there is no tourniquet applied: it will be known by its round open mouth, containing florid blood. If the artery should have retracted within its sheath of cellular membrane, so that this open mouth and the firm white coats of the vessel cannot be distinctly seen, as it is transfixed by the tenaculum, the sheath must be separated, or slit up, so as fairly to expose the artery before it is tied. The face of the stump is to be cleansed with a warm dry sponge, and the compression raised, provided no more vessels can be seen. Other arteries now show themselves; one is selected, compression is again made, and so on, until the whole are secured. When only three or four small ones remain, it is better to remove or entirely loosen the tourniquet; for, as Bromfield has observed, the repeated tightening and loosening of the tourniquet will cause a number of small vessels to

bleed, which, if it were removed, would contract, and not require the ligature. Any bleeding that ensues can be stopped by the points of the fingers on the vessels, until it be convenient to tie them.

Sometimes, after the principal artery of a limb has been secured, hæmorrhage will continue from its sides above the ligature, arising in general from some small branches which have been cut shorter, or have retracted more unequally than the principal trunk. Instead of puzzling at this for ten minutes screwing and unscrewing the tourniquet, and at last diving with a needle, and laying the foundation for a secondary hæmorrhage by pricking the artery; let it be transfixed and pulled out by the tenaculum, and separated a little with the scalpel from its connections, as high as these troublesome openings; when a ligature is to be put upon it, and the end of the artery cut off with the scissors; and I never saw this ligature pushed off a large artery when properly tied. This inconvenience is in general avoided by the division of the muscles; the operator taking care to divide the principal artery at one stroke of the knife, and with it half an inch at least of surrounding substance on each side, when these small vessels will give no trouble. This is another precaution which may appear trifling, but is often of great value.

When the tourniquet is applied close to the place of amputation, the muscles and blood-vessels contract within the limits of the action of the band of the instrument, and while it remains tight the principal artery cannot be discovered; occasionally, not even when it is loosened; in this case it is necessary to take it off altogether, for it presses upon the mouth of the vessel, or rather it presses the ends of the muscles against it; and very little compression upon the orifice of a large artery, such as the axillary, is sufficient to prevent it bleeding. It is in this way that the principal artery has not been found after amputation, of which I have seen several instances, which have sometimes given rise to very serious hæmorrhages.

When there is bleeding from any particular part, both venous and arterial, in larger quantity than can with propriety be overlooked, the part ought to be pressed upon by the points of the fingers, one on each side, or rather separated; the blood should then be absorbed by a small piece of sponge, when the vessel will be found retracted within the muscular fibres surrounding it, which prevent the flowing of the blood per saltum; if this fail, a slight touch with the scalpel will show the vessel, and save much unnecessary delay. I have seen the arteries of a stump occupy a person a quarter of an hour, and were not even then properly secured.

As each ligature is tied, one end should be cut away close to the knot, by which means they are prevented from acting in so great a degree as setons. The stump should lastly be sponged, but not washed with cold water, which will generally restrain any oozing that may occur. The only two cases of hæmorrhage after amputation, that I recollect ever to have happened to myself, were in consequence of neglecting this precaution; one in a Frenchman after the battle of Albuhera, the other after the battle of Toulouse. In the latter there was no oozing or bleeding whatever from the stump when it was closed, but two arteries soon showed themselves, and bled so profusely as to require the ligature. In neither instance did it affect the goodness of the stump, and I am disinclined to believe, where the operation has been otherwise well performed, that it will be a sufficient cause for the protrusion of the bone.

Some surgeons have lately adopted the practice of cutting off both ends of the ligatures, close to the knot on the artery; uniting the parts, if possible, over them, and allowing the knots to find their way out as they can. The edges of the wound, in some instances, have united thoroughly in a few days, and when the knots have come off the ends of the arteries, they have caused small abscesses to be formed, which point at the nearest external surface, and are discharged with little uneasiness. I know that many cases,

treated in this manner, in the campaign of 1813, ended successfully, and healed in as short a time as the most favourable ones by the usual method; and at Montpellier, in June 1814, M. Delpech, Professor of Surgery in that university, showed me at least twenty cases, in which he had tried this method with success. I have seen, however, in several instances, some ill-looking abscesses formed by the knots, which have appeared at various intervals of time, some after several months, prolonging the period of cure, and giving rise to much unnecessary uneasiness.

I consider this improvement as very valuable, in all cases that will not unite by the first intention. The ligatures, if there be many, form into ropes, are the cause of much irritation, and are frequently pulled away with the dressings; by cutting them off these evils are avoided, and the knots will come away with the discharge. It is adopting the practice, in a view diametrically opposite to that of its advocates, but it will be found very advantageous in all cases of operations performed in unsound parts, or in irritable or bad constitutions, where union will not take place, or only in a slight degree.

Since the foregoing observations were published in the first edition, several gentlemen have favoured the public with their opinions on the subject of ligatures cut close to the knot on the vessel; and the merit of adopting this plan has been claimed by many, although it does not appear to belong to any of those who have done so. Dr. Hennen has published from the seventh volume of the London Medical Journal, part of a letter from Mr. Lancelot Haire, of Southminster in Essex, dated November 1, 1786, in which he mentions having cut off both ends of the ligatures on the vessels with considerable success, and attributes the idea of doing it to a surgeon, a friend of his, whom he does not name. It is probable that this gentleman was really the first proposer of the method; but be this as it may, it is certain that it was not followed, and appears to have been forgotten (although Dr. Fergusson informed Dr. Hennen he saw it tried in Sweden in 1803),

until about the year 1813, when Dr. Physick in America seems to have practised it: and from some notice of it having reached Dr. Hennen, he was induced to try it at Bilboa, from whence it was introduced into the British army. It would appear that the French about the same period had received some intimation of it, although they seem desirous of claiming it as a discovery; and Mr. Lawrence in London introduced it into St. Bartholomew's hospital, as a new method. Whether the idea occurred to these different gentlemen at the same time, but independently of each other, is not of much consequence, as they have all been anticipated by Mr. Haire and his friend. The merit of the practice must be in its utility. I have given my opinion decidedly in favour of it in all cases of amputation which are not expected to unite by the first intention. The only remaining question is, whether the practice is equally good in cases in which union may be expected; and it has been urged in reply to my objections, that I have not stated the nature of the abscesses which took place in the cases to which I have alluded, nor the sort of ligature employed. When I wrote, I had only seen the common ligature used, which was made of silk in the usual manner, the knots of which were discharged in several different cases, by means of small abscesses which opened in the line of cicatrization, and in some instances leaving sinuses running down to the ends of the arteries from which they had separated. When this took place below the knee, it delayed the period of cure beyond the usual time, and might have given rise to disease in the stump, or, from its vicinity, in the bones themselves.

In the cases which have come under my observation, it certainly did not do so, although the knot had been retained for several months before it was discharged. The cure, upon the whole, did not appear to be much expedited, whilst the patient could not consider himself free from accident or uneasiness for several weeks or months.

Since the period at which I wrote, the inconvenience at-

tending the discharge of the knots has been attempted to be obviated by the substitution of dentist's silk by Mr. Lawrence, of catgut by Sir Astley Cooper, and of silkworm-gut by Mr. Fielding, on the principle, that partaking more of the nature of the animal body, they might be absorbed, or remain quiet without causing an irritation, which would give rise to the formation of abscess. There can be no doubt, if this could be accomplished, but the short-cut ligatures ought to supersede all others. The practice, however, has not been so favourable to them as to cause it to become general; and for my own part, I still prefer the single ligature, especially in all cases of amputation where there are two bones concerned.

When the ligatures are cut short, a single thread of the dentist's silk should be used instead of the more usual ligature made of common silk or thread; but opportunities have hitherto been wanting to prove in a satisfactory manner that this or other animal substances have been absorbed; although it is known, that other short-cut ligatures, when they have not been discharged, have been enclosed by thickened cellular membrane, forming a small knob by the sides of the vessels, in which they had remained in a perfectly quiet state*.

The opinion of the propriety of closing a stump by adhesive plaisters, with the view of obtaining union by the first intention, has been so long received in England as to become almost a law in surgery, and it may appear presumption to doubt its correctness; there are, however, many cases in which I am confident it does harm; and this circumstance forms an-

* For further information on the subject of ligatures, the reader is referred to a paper in the Edinburgh Medical and Surgical Journal, vol. ii, page 176, called the "Inquirer," by James Veitch, Esq., late of the Naval Hospital, Plymouth; Dr. Hennen's work on Military Surgery, page 174; Mr. Lawrence's papers in vol. vi and viii of the Medical and Chirurgical Transactions; Sir A. Cooper, in Cooper and Travers's Essays, part 1st; the American Medical Recorder, vol. ii, October 1819, in which Dr. Physick's claims are noticed; Mr. Cross, in the London Medical Repository, vol. vii; Mr. Fielding, in the second volume of the Trans. of the Med. and Chir. Society of Edinburgh.

other important point in the consideration of primary and secondary amputations.

In the civil hospitals in England, amputation is seldom attempted but in sound parts; in military hospitals it is often absolutely necessary to perform it in unsound parts. Surgeons in civil life always therefore endeavour, and in general with success, to promote union by the first intention; and in this practice they have been followed by military surgeons, without due regard being paid to the difference of circumstances. The Baron Larrey and a number of other French surgeons, having found the operation fail when they closed their stumps, and much mischief, or even death, ensue when the compression of the adhesive straps was considerable, have run into the other extreme, and direct that in no case should this adhesion or union by the first intention be attempted. Larrey says, page 379, vol. iii, "I do not unite the wound by the first intention. I have shown the inconvenience of this method in several parts of this work;" and at page 481 of vol. ii, after giving directions how to perform the operation, he says, "All that is required to keep the edges forwards, and near each other, is a circular bandage moderately tight, and a piece of linen having a number of eyelet-holes cut into it, which covers the wound; a little charpie is to be laid above this, and retained in its place by compresses in the form of a cross. The dressing is completed by a roller of sufficient length to regulate the action of the muscles and prevent their retraction, without passing over the face of the stump."

This differs but little from Mr. O'Halloran's method of dressing his flaps until suppuration is established, and then uniting them. In primary cases, it is certainly an unnecessary delay to the cure, as well as exposing the patient in many instances, where great attention cannot be paid, to retraction of the muscles, exfoliations of the bone, and all the evils that formerly attended this operation. It is unnecessary, however, to dwell upon this point in cases of primary operation in sound parts; the advantages of procuring union of the

stump in them are too well known to require discussion; and with all the respect I entertain for M. Larrey's opinions and experience, I cannot help thinking he has fallen into error, from not sufficiently discriminating between primary and secondary operations; or rather, between those performed in sound and unsound parts. No man can possess more facility in operative surgery than the Baron Larrey, and I conceive he must have met with the same successful results as the British military surgeons, if he could have been induced to employ the same means of cure.

In unsound parts, union by the first intention will not take place: their vital powers are frequently weak, and unequal to carry on any high action, or support themselves under it. When parts thus situated are brought into close contract by adhesive plaisters, the patient is easier for the first twenty-four or forty-eight hours, he then becomes restless, irritable, the stump swells, the constriction of the plaisters brings on inflammation, more evident however by the tumefaction than the redness of the parts. There is constant fever, a gradual prostration of strength, and the patient at the end of two or three weeks dies exhausted.

In other cases of secondary amputation, where the operation has been performed in parts apparently sound, and the wound has been brought into close contact, the symptomatic fever frequently returns with violence; although the integuments unite, with little or no external swelling or inflammation, and all appears to do well in the wound; yet the constitutional irritation increases rather than diminishes, the skin becomes permanently hot, the pulse very quick, with a gradual deterioration of all the symptoms usually attendant on irritative fever, under which the patient at the end of ten or fourteen days is carried off. On examining stumps of this kind after death, I have invariably found, although the integuments had united, and the line of incision had nearly cicatrized, or had in great part completely done so, that the muscles beneath were far from being in that situation; and in many instances, they were in a sloughing

or diseased state, which affected two or three different parts, where the continuance of disease had not caused the ulcerations to communicate. The ends of the great vessels have not always been concluded in the diseased parts, and have appeared perfectly healthy; at other times, sinuses have run up between the muscles and by the sides of the vessels, and I have seen them engaged in the disease, and containing pus. In four cases I found the femoral artery lying quite open on the face of a stump of this kind, without any apparent obstacle to the free passage of blood through it, and yet no hæmorrhage took place; which I cannot satisfactorily account for, having never seen the femoral artery lying open in any other wounds in which life had been preserved, without the occurrence of hæmorrhage*.

In the most favourable state of the stump the diseased parts do not extend very deep, yet the thickening of the cellular membrane composing the sheaths of the vessels is often considerable, and the disease is frequently communicated along the vein, which is found to contain pus even as far as the vena cava, inducing some gentlemen to suppose that the whole complaint arises from inflammation and suppuration of the great vein; and the knowledge of the same mischief occurring when the vena saphena has been tied, on account of varicose veins of the leg, has not a little contributed to support the opinion. When I have met with this appearance, I have always considered the vessels as participating in the disease, which had existed some days, and that they were not primarily affected. Having found in all of those that died, that there was ulceration or even sloughing in several places, or for a great part of the muscular surface of the stump under the united integuments; and observing in those that recovered, that the stump always opened out and showed a diseased surface, which afterwards granulated and healed from the bottom, I was led to believe, and still think, that the complaint commences on the face of

* See Dr. Thompson's Lectures on Inflammation, page 556.

the stump, and is the cause of irritation, which sooner or later is communicated to the vessels, when the fate of the patient is more quickly decided.

Whatever may be the original seat of the complaint, I never saw a fatal case in which there was not ulceration or sloughing of the internal part of the stump; and I am not conscious I have ever seen one that appeared to suffer in this way and yet recovered, in which the adhesion of the integuments did not in part, or totally, separate, and in which the antiphlogistic regimen was not strictly enforced. In cases of this kind, general blood-letting to a considerable extent, not taking away a few ounces every other day, but sixteen, or twenty, or even thirty ounces, three or four times in the course of the first three days of the complaint, abstinence, and opening medicines, will be of essential service in reducing the fever; but what I think of equal advantage, is the removal of the straps of adhesive plaister, and of all compression on the stump, the end of which should be laid in a warm poultice, and suppuration, and separation of the adhesion of the integuments, if any have taken place, promoted. But if the appearance of any part of the stump indicates the formation of an abscess, an incision should at once be made into that part, for the free evacuation of the matter. Diaphoretics determining to the bowels and skin, as the antimonium tartarisatum in small doses, are very useful. Under this treatment I have seen several recover, who under less decided measures would most probably have died. I believe the advantages of blood-letting to a greater extent than was formerly practised, in many cases of secondary amputation, are admitted by all military surgeons who have had much experience; and whether the disease begins in the vein or the stump, I believe the means recommended will be found highly useful.

Whenever there is irritative fever, with a stump partially closed, and discharging a little matter on pressure, I consider it in general indicative of disease going on beneath; and that if the state of the patient should not immediately demand

venesection, the state of the part requires a decided incision in the course of the sinus, and the dressing of the wound from the bottom, which may prevent further mischief.

A soldier submitted to amputation of the thigh, on account of a wound of the knee-joint, at the end of five weeks' suffering, on the condition that I would perform the operation myself; to this I consented; the man bore it very well, and appeared to improve for two or three days, when his fever returned, his appetite gradually failed, and he became weaker; the stump in the mean time looked well, covered completely, and by the fourteenth day the integuments had united over the bone and the surface of the stump, except in one small space, from whence a little matter could be squeezed on pressure. He died at this period, completely exhausted by the constant state of febrile irritation. The stump underneath the integuments was unsound, and caused all the irritation which took place. This state of stump is another of the disadvantages more particularly attending secondary operations, as it does not follow those performed on the field of battle in an equal proportion.

Private Alexander Clarke, of the 79th regiment, was wounded at the battle of Waterloo by a musket-ball, which fractured the femur a little above the knee-joint, and was admitted into the York Hospital in November 1816. On the 20th of January, in consequence of the femur being in a state of necrosis as high as the little trochanter, accompanied by great pain and discharge, I amputated the thigh at the great trochanter; he bore the operation well, and lost very little blood. Pulse before, and in the evening after the operation, 104. The bowels were kept open, saline medicines administered, and the stump kept cool. On the 25th, the pulse had risen to 120, but was weak; he looked irritable, but his skin was cool, and the tongue moist. During the 26th and 27th, symptoms of low fever gradually came on, and on the 28th he suffered severely from vomiting, and the accession of continued fever was well marked; skin hot, tongue dry,

great sickness, general uneasiness, greater prostration of strength, pulse 120 and weak, and the stump, which had not united externally, discharged good pus. On the 30th he continued in the same state, but his skin assumed a yellow tinge. On the 1st of February he had a well-marked rigor, resembling the fit of an ague. I suspected the formation of matter in one or other of the viscera, or in the stump, but could not satisfy myself as to the part; the symptoms now assumed more and more the character of typhus gravior, and he died on the 8th. I predicted, before opening the body, that the liver was diseased, that there was in all probability an abscess in it, and the nature of the fever led me also to suspect inflammation of the veins of the stump, which had been for several days enveloped in a poultice. On dissection, the liver was found enlarged, weighing six pounds ten ounces; there was not however any abscess in it. On examining the stump, an abscess containing four ounces of good pus was found at the under part of it, near the bone. The great vein, and those running to that part of the stump, were inflamed, containing coagulable lymph and purulent matter, which even extended up to the cava: the remaining portion of bone was not perfectly sound, and healthy action did not go on at that part; the rigor on the 1st of February marked the formation of matter, and the typhoid symptoms afterwards indicated the inflammation of the veins, by which in these cases it is usually attended until its termination in death. I had from the third day, on the first dressing, discouraged union by the first intention; two ligatures only remained; and if I had discovered the abscess, and fairly opened it, I think it possible I might have saved my patient, in spite of the disease of his liver, which was considerably augmented by the febrile irritation ensuing after the operation. In this case I was deterred from bleeding by the debilitated state of the man, and from the character throughout of the febrile symptoms.

In all such cases, the acceleration of the pulse on the fourth or fifth day ought to excite suspicion, and, if the patient can

bear it, blood should be taken away, and the treatment alluded to carefully enforced. The stump should be closely examined, and, if there be any signs leading even to the suspicion of an abscess, a free incision should be made into it. In such a case, I have made four in this manner, deep into the lower part of the stump, and with decided success.

Frequently, however, the disease in unsound parts does not go on so slowly; the stump becomes so swelled and painful that it cannot be brought together after the first dressing; and if it be attempted, as is frequently done, by force, the most serious mischief ensues; the stump sloughs, the ligatures come away on the fourth or fifth day, the discharge is profuse, and as the powers of the part are weak, and unable to support the action caused in them by the operation, and by the subsequent pressure attending the attempted union, gangrene rapidly approaches, and destroys the patient. In several cases under these circumstances, it has appeared to have proceeded no further than coagulating the blood in the vessels of the stump, before the patient was destroyed.

In all such cases, and many must have occurred to every military surgeon, the adhesive plaisters are at last removed, and fomentations and poultices applied to the stump; but the mischief has proceeded so far in general, that it cannot be arrested, and the patient dies. The stump, when the poultice is applied, or when the straps of plaister are removed, is in a state further from healing, even if the mischief be stopped, than it would have been at first after the amputation was performed, if union had not been attempted. The process of cure in both must be alike, and equally subject to the evils resulting from the suppuration of the stump; it is certainly then better to adopt that practice at first, which must often of necessity be followed, when the parts are in a much worse state, the constitution more irritable, and the prospect of success less encouraging. It was in this way, that all the amputations after gangrene, that I have seen prove fatal, have ter-

minated; death taking place before the stump was in the complete state of sphacelus.

The first edition of this work having been published before the battle of Waterloo, the attention of the younger surgeons was attracted to these facts, and I personally requested that examinations might be made of the stumps of every man that died. My friends at Brussels, Antwerp, Yarmouth, and Colchester, were anxious to give me every information on this, as well as every other subject, and all that I have obtained has been confirmatory of the facts I have alluded to. In all cases in which the veins were diseased, the stumps had put on an unhealthy sloughy appearance. In some, the veins alone were engaged; in others, but very rarely, the arteries only were affected; and, in a third set, both vessels partook of the diseased action, but that in the arteries was confined to the neighbourhood of the part. That the inflammation of these vessels is not a primary affection, inducing the suppuration or abscess in the part, but dependent on (or, at all events, only coeval with) the suppurative inflammation, is the opinion I advanced some years ago, without recollecting that it was the same as Mr. Hunter had given in 1784*. He says, after describing the appearances observed on dissection, "As these appearances are only to be seen in dead bodies, they cannot be described but from thence; but it is so common a case, that I have hardly ever seen an instance of suppuration in any part furnished with large veins, where these appearances are not evident after death. I have found them in the bodies of those who have died from amputation, compound fractures, and mortification."

Upon this statement Mr. Travers has commented, in his excellent Essay on this subject, in the first volume published conjointly by Sir A. Cooper and himself, page 249, and is dis-

* Observations on the Inflammation of the internal Coats of Veins. In the Transactions of the Society for the Improvement of Medical and Chirurgical Knowledge, vol. i, 1793.

posed to think, "that Mr. Hunter must have meant a sympathetic inflammation, *i. e.* one which does not arise out of violence done to the vein, but consentaneous with disease of the surrounding parts;" and supposes that there must be too much latitude in the statement, inasmuch as the femoral vein, in a psoas abscess, in abscess of the hip, and the subclavian and axillary in an abscess of the shoulder-joint, which had destroyed the bones, ligaments, and much of the surrounding muscular parts, showed no signs of disease. Mr. Hunter, in the commencement of his paper, says, "The following observations will show, that the inside of veins, as well as of all other cavities, is a seat of inflammation and abscess. I have found in all violent inflammations of the cellular membrane, whether spontaneous or in consequence of accident, as in compound fractures, or of surgical operation, as in the removal of an extremity, that the coats of the larger veins, passing *through* the inflamed part, become also considerably inflamed; and that their inner surfaces take on the adhesive, suppurative, and ulcerative inflammations, &c." He has here stated, that it takes place in spontaneous inflammations, but he does not refer to one instance, in the course of his remarks, in which the inflammation and suppuration did not occur from external violence; and in explaining how it takes place after bleeding, he says, page 21, "The manner in which these sore arms come on, shows plainly that they arise from the wound not healing by the first intention, for the external wound, in most cases, first festers or inflames, then suppurates and ulcerates, so that the cavity of the vein becomes impervious. In some this suppuration is only superficial, the vein and parts below having united. In others, the skin shall appear to be united, but not close to the vein, so that a small abscess shall form between the skin and the vein; it shall burst, and discharge a thin watery fluid, and no further mischief happen; *but when this imperfection of union is continued on to the cavity of the vein, then the vein inflames both upwards and downwards, and that often*

for a considerable way, and the surrounding parts join in the inflammation."

Mr. Hunter has here distinctly shown the necessity for an external injury, and the communication of an action which originated external to the vein, which explains away the difficulty under which Mr. Travers labours, on account of this inflammation not taking place in veins which had no opening in them. It should also be recollected, that Mr. Hunter does not say the inflammation and suppuration *must* follow in every case, but that he had *hardly* seen an instance of suppuration in any part furnished with *large* veins, without its taking place. When a psoas abscess is opened, and irritation comes upon the sac, the symptoms entirely resemble those which ensue from inflammation and suppuration in a vein; and although, as Mr. Travers has remarked, the femoral vein may not be affected, still the veins running from the sac itself may be so; and I have a strong suspicion that they are affected by inflammation, and probably by suppuration, a circumstance which may perhaps have escaped observation. It is worthy of remark, that Mr. Travers has not adduced an instance of a spontaneous acute abscess or inflammation being the cause of this disease; neither has Mr. Hodgson, in treating professedly on the subject, in his work on the Diseases of Arteries and Veins, although he notices many cases, in which obliteration of the veins had taken place from internal causes, in none of which the patients died from this disease; nor does Mr. Carmichael, in his paper on the subject, inserted in the second volume of the Transactions of the Dublin College of Physicians. The cases related by Mr. Wilson, in the third volume of the same work as Mr. Hunter's, rather confirm this opinion, as the veins which were inflamed originated from the internal surface of the arteries in a state of inflammation. In the dissection of a woman, who died four or five weeks after delivery, Mr. Wilson found the coats of the principal veins of the uterus thickened, and partially obliterated. "The common,

the external, the internal iliac veins, with most of their larger branches, particularly those which returned the blood from the uterus, as well as the emulgent and spermatic veins, exhibited the effects of inflammation. Their coats were thickened, and their cavities obliterated by lymph or plugs of coagulum. The coats of the vena cava inferior were at least three times thicker than natural, and adhered very firmly to the surrounding parts. This vessel contained about four ounces of well-formed pus, which had been prevented from passing to the heart, partly by a contraction or puckering of the vessel immediately below the entrance of the three large venæ cavæ hepaticæ, and partly by a quantity of coagulable lymph, which adhered to its coats, and plugged up the cavity of the vessel, to the extent of about a quarter of an inch. A quantity of coagulable lymph, intimately adhering to the inside of the vein, had completely filled up its cavity from the emulgent veins downwards. In two other cases of women who died a few days after parturition, he found that some of the larger veins of the uterus contained pus, and in both the obliteration of part of the vena cava inferior, by coagulable lymph strongly adhering to its inner surface, and filling up its cavity."

It should also be observed, that the application of a ligature to a vein does not always cause irritative inflammation, neither does the formation of an abscess in its immediate vicinity. I have seen many ligatures applied on veins without the slightest inconvenience following; and on examination, after death, I have found that ligatures had not been applied in by far the greater number of cases, in which inflammation and suppuration of the principal and anastomosing veins had taken place. When Mr. Hodgson says, page 555, " that division of veins in amputation is never, or very rarely, followed by those violent symptoms which are sometimes the consequence of tying a dilated vein;" the opinion must be received with caution, and should not be brought in support of the practice of dividing varicose veins, and applying a compress

instead of a ligature, which is certainly the best mode of doing the operation, but not devoid of the same danger, of which indeed he gives proof in several fatal cases.

From these observations I am disposed to conclude, that irritative inflammation of veins scarcely ever occurs, except as a consequence of external violence applied to the vein or to the neighbouring parts, the peculiar action of which is communicated by continuity to the vein itself. I think that this is what Mr. Hunter meant; and as Mr. Travers has professed his determination to prosecute the subject further, I hope he may be able to prove or disprove my surmises. The point I wish to press is the practical one, to open the stump by incision, and give a free exit to the matter; to encourage the further secretion of it, by enveloping the part in a poultice; to promote adhesion in the veins above, by the application of cold in the course of the great vessels; to diminish the general irritation by bleeding, and to sooth the system by opiates and saline diaphoretic medicines. I do not believe, in any of these cases, that purulent matter is carried into the general circulation, for the office of the vein seems to cease with the inflammation of its internal tunic, precisely in the same manner as in an artery under similar circumstances, through which no blood passes, although impelled with the direct force of the heart.

"Jane Strangemore, aged twenty-eight, was admitted into Westminster Hospital, September 24th, 1823, with an elastic swelling of the whole of the knee-joint, measuring twenty-seven and a half inches in circumference. The swelling began in the upper part five months previously, and gradually attained its present size, attended during its formation by severe paroxysms of pain, which have for the last three weeks been so violent as to deprive the patient of rest. Her general health is good, and she has suckled a baby for the last seven months, a fine healthy child.

"The thigh was amputated by Mr. Guthrie on Saturday the 27th, the bone being sawn through just below the trochanter.

She suffered a good deal of pain after the operation: an opiate was administered and repeated, and she passed a good night.

"28th. The pulse, which, previous to the operation was 80, had increased to 100; there is, however, little heat of skin, and she appears easy. Some aperient medicine and saline draughts to be given every four hours. Towards the evening the stomach became sick, she vomited a quantity of bilious matter, pulse 120. Three grains of calomel and one of opium, followed by the common aperient mixture, were ordered, and an enema. The region of the stomach, to which part pain was referred, is to have applied to it equal parts of ether and laudanum.

"29th. Bowels well evacuated; pain and sickness subsiding.

"30th. Appears better; stump dressed, and looking well: pulse 120.

"October 1st. Better in all symptoms, but looking irritable and ill. No pain anywhere; no sickness; appetite good; pulse still quick.

"4th. The house surgeon called up in the night, on account of pain in the stump, which was relieved by changing the dressing.

"8th. Two ligatures have come away. The wound looks well; the edges have nearly healed. Eats meat, and with a good appetite.

"9th. Not so well; pulse 120; skin hot; feels ill; complains of pain in the other leg and thigh, which disturbed her rest. Was well purged, and the leg fomented. Towards evening, the pain was principally felt in the calf and in the heel.

"10th. Pulse 130; tongue furred; vomiting again of bile. The pain in the thigh, extending upwards to the groin and downwards to the heel, is intolerable, particularly in the latter part. The thigh and leg much swelled, and tender to the touch, although without redness. The swelling elastic, yet yielding to the pressure of the finger, but not in any manner

like an œdematous limb. Mr. Guthrie pronounced the disease this morning to be inflammation of the veins, extending from the opposite side; but after a careful examination, and on pressure, no pain was felt in the course of the iliac vessels of that side; and the stump looking well, save at one small point corresponding to the termination of the femoral vein.

"17th. The symptoms continued nearly the same during the week, the sickness of stomach and purging of bilious matter abating at intervals.

"18th. Is better, and the pain is diminished. She looks somewhat better, but is becoming thinner.

"20th. Less pain in the limb, which is swelled, tender to the touch, and all the superficial veins are very much enlarged. The groin more swelled and tender. Sickness gone, and her appetite returning; and is allowed good, nourishing, simple diet. The stump had been poulticed since the 9th, to promote suppuration.

"25th. During these five days, it was interesting to see the patient eat, and desire solid food, and in her extremely emaciated state seem to enjoy it. The bowels occasionally deranged. Pulse always from 126 to 136. Is slightly jaundiced in colour, but declares she is better, and will get well.

"Monday, 27th. Gradually sunk in the evening, and died; the limb having everywhere diminished in size, except at the groin, where the swelling was more circumscribed, resembling the appearance of a chronic abscess approaching the surface.

"On examination after death, the termination of the vein on the face of the stump was open, and in a sloughy state; above that, for the distance of four inches, and as high as Poupart's ligament, the inside of the vein bore marks of having been inflamed, but the inflammation seemed to have been of an adhesive character: above that point, the inflammation appeared to have been of an irritative or erisypelatous kind, had gone on to suppuration, and the vein was filled with purulent matter, lymph, and blood, partly coagulated, partly broken down. These appearances extended up the cava beyond the

diaphragm, and traces of inflammation could be distinctly observed almost in the auricle. This disease had passed along the right external iliac and its branches; it had descended along the left iliac vein, affecting its branches in the pelvis to the uterus, and along the limb to the sole of the foot. At the left groin, the iliac vein becoming femoral, was greatly distended with pus, apparently of good quality; and if the patient had lived a day or two longer, it would have been discharged by a natural effort, as in chronic abscess.

"The viscera were healthy.

"During the last days of this woman's life, no blood was returned from the lower half of the body, unless by the superficial veins; yet she was comparatively easy, although of a yellow hue, emaciated to the utmost, so as to represent a living skeleton; and in this state, with a pulse at 130, craving for and eating a whole mutton chop, and more, at a time, with the most deathlike countenance it is possible to conceive."

This case was reported by Mr. Dakins, the house surgeon of the Westminster Hospital, and is confirmative of the opinions I have advanced. It was published in the London Medical and Physical Journal for July 1826, for the purpose of drawing the attention of the profession to several points, which had not been duly noticed.

1st. That inflammation of the veins is of two kinds, the adhesive, or healthy, and the irritative, or unhealthy, embracing all the different shades between them. The first kind is seldom observed when it takes place, and when observed is usually cured; the latter is almost invariably fatal. When a person, after undergoing amputation, is about to suffer from unhealthy inflammation of the veins, the pulse quickens and continues above 90, usually from 100 to 130, until his dissolution. There are frequent attacks of vomiting, for the most part of a bilious character, accompanied by the common symptoms of fever: the tongue is white; the patient is sleepless, restless, and anxious. After the first few days

there is usually a well-marked rigor, and this may be followed by others; but the exacerbations and remissions of fever are evident; the skin becomes tinged of a yellowish hue, and is often covered with perspiration; the bowels are very irregular; the pulse becomes weaker and more irritable, and increases in frequency as the disease goes on. The patient gradually sinks; or the febrile symptoms subside, with the exception of the frequency of the pulse, which also may even be diminished; he rallies a little, and the appetite returns; but whilst he says he is better, and will get well, the daily, nay almost hourly deterioration of the appearance is well marked, and a slight accession of fever soon closes the scene. The stump is not in more pain than in many other cases in which no inconvenience follows, and frequently there is neither more pain nor suffering than is common to the operation; neither is there any remarkable pain or tenderness in the course of the vessels.

2dly. Dr. Davis, in his paper in the twelfth volume of the Medical and Chirurgical Transactions, has stated, "that phlegmasia dolens occurring in puerperal women is caused by an inflammation of one or more of the principal veins within and in the immediate neighbourhood of the pelvis;" and he conjectures, that it takes place in them in consequence of their being previously disposed to it, from the inconvenience, pressure, and excitement they sustained during the period of pregnancy. This hypothesis obtains support from the fact stated in the different dissections related by Dr. Davis and others, that the uterus and its appendages were sound, or in their natural state. Without having the slightest intention to dispute the accuracy of the gentlemen who made these dissections, it is possible to conceive, that not having a suspicion of the probability of the veins passing from the uterus being or having been inflamed, they might not have made this a point of minute investigation; and I therefore suggest for the future the propriety of tracing the veins from the common iliac of the affected side down to the uterus. I think it probable,

that the inflammation of the veins will be found to have begun at the uterus, and to have ascended along a continuous surface, until it implicated the veins of the extremity. The inflammation being often at the commencement in a great degree adhesive, and the uterus not quite in a healthy state, in the generality of cases in which an examination takes place after death, the traces of inflammation may be readily overlooked in the part, and the veins leading from it, unless they are made objects of especial observation. This supposition is founded on the opinions Mr. Hunter entertained on this subject, and which I have endeavoured to elucidate and support in the preceding pages. How far it or they may be correct or erroneous, remains yet to be shown.

Another and very serious evil frequently resulting from the improper attempt at procuring union, is necrosis of the bone; for, whenever the soft parts of the stump become diseased in the manner I have represented, the bone soon participates in it, and a very tedious cure is the consequence.

From the consideration of all these circumstances in amputations performed from necessity, in parts in a diseased state, as in most secondary amputations after compound fracture of the thigh, where the parts are unsound, I am induced not to insist upon the edges of the wound being brought into close contact by sticking plaister, compress, and bandage. The bone should, in order to prevent its protrusion, be sawed an inch shorter than usual, or than would be necessary in amputation under other circumstances; the ligatures should also be cut off close to the knot, by which much irritation will be avoided. The integuments and muscles are to be brought forward in the usual manner, but not laid down in contact over the bone, and retained by the roller put on moderately tight; some fine lint spread with cerate or dipt in oil is to be put between the edges of the wound; a piece of linen and a Malta cross over it, and a few light turns of the roller, finish the dressing, In some cases I have put one, and even two straps of plaister over the stump, to keep the edges approxi-

mated without being in contact; and where the parts are but little diseased, this may be attempted; but, if the stump becomes uneasy, they should be cut, and a poultice applied. When only a part of the stump has appeared to slough, I have found the spiritus camphoræ alone, or diluted with a watery solution of opium applied with the lint, very useful.

In the irritable and sloughing state of stump that has been noticed, hæmorrhages frequently take place from the small branches, or from the main trunks of the arteries, in consequence of ulceration; and it is not always easy to discover the bleeding vessel, or, when discovered, to secure it on the face of the stump; for, as the ulcerative process has not ceased, and the end of the artery which is to be secured is not sound, no healthy action can take place; the ligature very soon cuts its way through, or is thrown off, and the hæmorrhage returns as violently as before; or some other branch gives way; another ligature is required, which is equally uncertain; and under this succession of ligatures and hæmorrhages, the patient dies. Surgeons have, in such cases, preferred cutting down upon the principal artery of the limb, in preference to performing another amputation, even when it is practicable; and they have frequently succeeded in restraining the hæmorrhage for a sufficient length of time to allow the stump to resume a more healthy action. This operation, although successful in many cases, will, under certain circumstances, fail, and amputation become ultimately necessary; but the same objection of want of success may be made to amputation; and, on a due comparison of the whole of the attending circumstances, I recommend the operation of tying the artery, in most cases, in the first instance; and if that prove unsuccessful, of resorting to amputation; but this practice is by no means to be followed indiscriminately. The artery is to be secured with reference to the mode of operating, as in aneurism; but the doctrines of this disease are not to be applied to it, because it is still a wounded vessel with an external open-

ing, which truth I have more than once seen proved to the discomfiture of the surgeon who relied upon them.

In the thigh, the operation is less certain than in the arm, and especially if it is not the main artery that bleeds; for the branch from which the hæmorrhage proceeds may come from the profunda, and tying the artery in the groin on such opinion, would be doing a serious operation, and one which would probably not succeed; for the anastomosing branches would restore the circulation in the stump in a short time, and again establish the bleeding. If it is the femoral artery that bleeds, and the ligature is applied high, it is very liable to a return of the hæmorrhage. To obviate these difficulties, the part from which the bleeding comes should be well studied, and the shortest distance from the stump carefully noted, at which, compression on the artery commands the bleeding; and at this spot the ligature should be applied, provided it is not within the sphere of the inflammation of the stump. In case the hæmorrhage should only be restrained by pressure above the origin of the profunda, and repeated attempts to secure the vessel on the surface of the stump had failed, I would prefer amputation, where the strength of the patient would bear it, to tying the artery in the groin, which I do not think would be successful; and the patient would be then in a less favourable state for amputation.

In a bad state of stump below the knee, attended with hæmorrhage, the artery, whether the anterior or posterior tibial, should, if possible, be secured; and if this should not succeed, amputation should be performed above, in preference to tying the artery in the thigh, which most assuredly would fail. The popliteal artery may be taken up in these cases with much more ease and advantage than in aneurism, and may be tied when the stump is likely to do well, if the bleeding had ceased, but not otherwise. Mr. Berry, in a case of this kind, tied the popliteal artery with success.

In a bad stump below the elbow with hæmorrhage, amputation above the joint is to be preferred to tying the

brachial artery; for, as this would not be a certain operation, and the stump when healed a bad one, and always exposed to injury, the amputation would be most advantageous for the patient.

When hæmorrhage takes place after amputation at the shoulder-joint, it is a most dangerous occurrence: more particularly if it occurs in consequence of ulceration. In no case is the artery to be struck at by the needle, but an incision is to be made through the integuments and great pectoral muscle, when the artery may be readily exposed, and a ligature be placed upon it without difficulty anywhere below the clavicle.

If the state of the stump in any of these cases depend upon the bad air of the hospital, I would expose the patient to the inclemency of the weather rather than allow him to remain in it; for I know that the effects of any exposure must be less certainly fatal to the patient, than a continuance in the same atmosphere.

It often happens, in cases of this kind, that the stump has not united, or, in opening out, has given rise to a protrusion of the bone, forming a conical stump, the skin has retracted, and the face of the stump, in granulating, is exposed, and becomes irritable. In crowded hospitals, hæmorrhage from the face of such a stump is not unfrequent, and often causes a great deal of trouble to the surgeon and much distress to the patient. It is not a direct bleeding from a vessel of sufficient size to be discovered and secured, but an oozing from some part of the exposed granulations, which are soft, pale, and flaccid. On making pressure on them, the hæmorrhage ceases; but shortly after dressing the stump it reappears, and even becomes dangerous. After the battle of Salamanca and that of the Pyrenees I had several instances of it; there were not any at Toulouse. After the battle of Waterloo they were sufficiently numerous. Dr. Thompson* has very justly observed, that this hæmorrhage

* Report of Observations made in the Military Hospitals in Belgium, 1816.

is usually preceded by pain, heat, and throbbing in the surface from which it proceeds. I have always found a disposition for hæmorrhagic action in all the vessels of the stump, irritation of the habit generally, and a tendency to direct debility. In some of the cases after the battle of Waterloo, Dr. Thomson thought he observed it more particularly in persons of a sanguine or plethoric temperament, after improper indulgence in the use of a nourishing or stimulating diet, which certainly may be one predisposing cause of it. I do not, however, believe it would be sufficient in persons of a full habit, unless they were exposed to the bad air of a crowded hospital, and other causes of general derangement. My observations have not led me to infer, that persons of a sanguine temperament are more disposed to it than those of a lax and loose fibre. The proper treatment is the cooling antiphlogistic regimen, cold to the stump in the shape of pounded ice, or iced water; with occasional styptics to suppress the immediate bleeding. Escharotic and stimulating applications must be used with great caution, as they have a tendency to increase the mischief.

A protrusion of bone is another unfavourable occurrence after amputation, when ill performed. It will sometimes, however, happen after sloughing of the stump, or other accidental circumstances, without any fault on the part of the operator. That part of the bone which is exposed, dies, and after some time exfoliates, leaving a very conical stump; and upon this subject some good remarks may be read in the Mémoires de l'Académie de Chirurgie. It will almost always be prevented by attention to the following circumstances: 1. To leave the integuments attached to the muscles, instead of turning them back. 2. When the muscles are cut through (and it does not signify in what manner), to separate them for the space of at least three inches from the bone, so that it may appear at the bottom of the cone, as a depressed point; the muscle in contact with the side of the bone, meeting its fellow on the opposite side immediately on the face of it, and having over

it another layer of muscle; and, lastly, the integuments. 3. To cut the bone short, and to keep the thigh constantly bandaged from the trunk during the cure, so as to prevent the retraction of the muscles.

If a surgeon, after having completed his amputation, finds, on bringing the parts together, that the bone cannot be well covered, and that it will in all probability protrude in the course of a few days, he ought not to leave it in this state, but immediately saw off as much more bone as will reduce it to its proper length. The error may be remedied at this moment with very little comparative inconvenience to what it will occasion hereafter: and no false shame should prevent its being done at the moment, if the state of the patient will admit of it.

When the bone has protruded at a subsequent period, it has been disputed whether it should be sawed off, or allowed to exfoliate.

Where there is only a very little protrusion, or rather, the point of the bone appears in the middle of the stump, the muscular part of which has been well kept forward, it will be the best practice to allow the exposed bone to exfoliate; for it must not be overlooked, that if the protruded part be sawed off, which is done with pain and difficulty, an exposed surface will still remain, which must also exfoliate before the stump can heal.

If the bone should protrude for one or two inches, which I have frequently seen in the first operations of gentlemen entering into the service, the stump will be very conical and bad; granulations will grow up around the bone, the exfoliation of this piece will be long delayed, and, when accomplished, the stump will still be very conical, tender, and always obnoxious to injury. In these cases it should be removed by an operation, and the saw should be applied on the sound bone, immediately above the part originally exposed; for, if it be sawed below, little will be gained by the operation. It should be done before the granulations surrounding the bone have

begun to skin over, or it will be more difficult and painful. The tourniquet is to be put on for fear of accident: the exposed bone must be held firmly with a pair of pincers, or introduced into any hollow tube which cannot move round it; the granulations are to be cut through to make room for the saw; the muscular part of the stump is to be retracted as much as propriety will permit, and defended from the action of the saw while the bone is removing. The stump is to be afterwards kept wet with cold water, the thigh well bandaged, and the exfoliation of the bone touched by the saw awaited, which will still occupy some time. The advantage gained by this operation is in the end a better stump, and, during the cure, a greater tranquillity of mind; for, while the bone is protruding, there is always much anxiety.

The things called stump caps, which were originally intended to be applied at the first dressing as a component part of it, were only used during the Peninsular war, to keep the stumps warm after the cure was completed, being in fact the sole purpose to which they are really applicable.

When amputations performed on the field of battle, and those delayed until suppuration is established or the first symptoms of inflammation are over, are carefully compared with each other, according to the different views I have given of them, it will be perceived, that the dangers attendant on secondary operations in military surgery are infinitely greater than those on primary operations; and the result of the practice of the whole of the surgeons of the British army, and of a great part of the French army, as given by the Baron Larrey, ought to be decisive on this point, and establish it as a law in surgery, "That when amputation, in any case, is indispensable, it ought to be performed immediately after the injury, provided the state of the patient will admit of it; and it ought not to be delayed, under any circumstances, beyond twenty-four hours, with the view of obtaining a more favourable opportunity for its performance."

I shall conclude these observations by a report commu-

nicated to me by the late Mr. Wasdell, Surgeon to the Forces, who was left at New Orleans in charge of the British wounded, which cannot fail, in addition to those already given, to establish the advantages of early amputation, if further corroboration could be required.

Return of the Operations of Amputation performed in consequence of Wounds received at the Attack on the American Lines in front of New Orleans, from the 8th of January to the 24th of April, 1815.

OPERATIONS.	Number operated upon.	Of which died.	Discharged, cured.
PRIMARY.			
Amputation of the Thigh	7	4	3
——— at the Shoulder Joint	3	0	3
——— of the Leg	26	3	23
——— Arm	9	0	9
Total	45	7	38
SECONDARY.			
Amputation of the Thigh	4	2	2
——— Leg	2	2	0
——— Arm	1	1	0
Total	7	5	2
Grand Total	52	12	40

ON PARTICULAR OPERATIONS.

Before entering upon the subject of particular amputations, it may save some repetition to state the practice to be followed in all cases where a limb is torn away by a cannon-ball. The opinions of authors have been, and are still, in opposition on this subject; Bilguer and his followers declaring, that when the bone is broken short off, it is only necessary to cut away the ragged edges of the wound, and await, with a smooth surface, the processes of suppuration and granulation for a cure, which may then be effected in five or six months; and this opinion is still maintained by Lombard* and other French modern surgeons, although it is strenuously disputed by M. Larrey, vol. ii, p. 263, and in other parts, in consequence of the bad success he had seen attend the practice.

Most other surgeons consider amputation in sound parts above the injury as absolutely necessary, and this has been the invariable practice of the British surgeons during the Peninsular war, without a single exception; and it is to be hoped that there are but few who entertain the contrary opinion. The only thing they propose to themselves is, to avoid the pain of the operation of amputation, which may be considered momentary, when compared with the tedious misery of a five months' cure. The pain of amputation is, indeed, but trifling in comparison with the dreadful torture of a shattered limb, of suppuration, ulceration, exfoliation, &c. as detailed even by its advocates; and an unfortunate termination will more frequently occur in this state than after amputation.

It is unnecessary to enter more fully into this subject. No unprejudiced surgeon can entertain the opinion; neither has it been entertained by British military surgeons for many years.

* Clinique chirurgicale, à Lyon, 1804.

Of Amputation at the Hip-Joint.

This operation has been seldom performed. Surgeons have agreed in calling it a dreadful and a horrible operation, and of expressing their dislike to it by intimating, that the advocates or the proposers of it were guilty of little less than murder. Both the British and French military surgeons of the greatest talents, with a few exceptions, have considered it as a hopeless operation, and the performance of it an unnecessary cruelty, unworthy the character of a surgeon; and from this conviction they have not only had no hesitation in saying, that they could not be persuaded to perform it themselves; but they have suffered it to be understood, that the attempt at performing it was the foolish or barbarous cruelty of men who were desirous of gaining notoriety by any means, without considering the lives of the persons entrusted to their care, or that humanity, which, tempered with firmness and judgment, is the brightest ornament of the surgeon. Prejudiced against the operation without having tried it, surgeons have not only suffered their own patients to die unassisted when this operation alone could bring relief, if any was to be obtained; but, by the respectability of their opinions on these subjects, they have influenced the minds of others, who had conceived the idea of executing it with success, and thus have prevented its being tried.

The evil in surgery does not however stop here: if any one or two men are unsuccessful in their first attempts, they are obliged to desist from a repetition of the operation, or hazard the loss of their character for humanity and judgment; and it is only by being in a high situation, or of great authority in the profession, that they can silence the clamour or insinuations of idle people. It behoves all surgeons, therefore, to avoid giving their negative opinions too strongly upon subjects of which they have not had actual experience; for they not only refrain from doing good themselves, but they prevent others from attempting it, and thereby enable

many unqualified persons to object to an operation as impracticable and improper, because they feel that they are unequal to the performance of it.

I consider this prejudice against amputation at the hip-joint common to both British and Continental surgeons, and the cause that so few cases of its performance, or of its success, are on record. Now, however, since successful cases are known to have occurred, and the propriety of the operation, under certain circumstances, has become more evident, the opinions of its adversaries have lost much of their weight; and had the war been prolonged another year on the Peninsula, or in Flanders, I am satisfied, cases demanding it would have been found sufficiently numerous; and it would have been comparatively as much practised, as the sister operation at the shoulder-joint, which was but a very few years ago considered almost equally dangerous.

The more modern surgeons in civil life have not been less decided in the opinion of the impropriety of performing it, and they have carefully refrained from noticing it in their surgical works; or, when they have noticed it, it has only been to express their disapprobation. Teachers of surgery have, for the most part, by their omission of it in their lectures, tacitly admitted that it ought not to be attempted; and fear has so much pervaded the minds of all, that it is generally regarded in domestic surgery with as much horror as the attempt at putting a ligature on the external iliac artery would have been a century ago, if such an operation had been proposed.

The opinions of military surgeons, supported by their practice, are getting the better of this prejudice, and few surgeons of any pretensions to eminence would now refuse to perform it.

That it was once performed in London*, appears from the works of Mr. Pott, who saw an operation of the kind, and

* It is said by Mr. Henry Thompson of the London Hospital.

expresses his opinion of it in the following terms: "That amputation in the joint of the hip is not an impracticable operation (although it be a dreadful one) I very well know: I cannot say that I have ever done it, but I have seen it done, and am now very sure I shall never do it, unless it be on a dead body."

Amputation at the hip-joint is certainly a formidable operation to the patient. The removal of nearly one-fourth of the body must always be attended with the greatest danger, and must frequently be unsuccessful. It does not, however, follow that it should never be performed; on the contrary, when there is no chance of life, unless relief be obtained by the removal of the injured part, the operation should be resorted to, in compliance with the precept of Celsus*. "Nihil interest an satis tutum sit præsidium, quod unicum est," which, on this occasion, is peculiarly applicable. The patient should be apprised of his situation, of the impending danger, and the chance he has of escaping death; and although this chance be small, still the love of life makes us grasp at any thing that holds out a hope of preserving it, and very many, under these circumstances, will submit to the operation.

Authorities on this subject are but slender. There is little to be obtained from books which can assist the surgeon, either in his mode of performing the operation, the time of doing it, or in pointing out the kind of injury that requires it to be done; and the practice of no individual has been hitherto sufficiently extensive, to allow him to give, from his own experience, general rules that can be considered on all these points as conclusive. No operation, therefore, in surgery, deserves more the attention of surgeons. The cases in which it is requisite are not all known, or, if known, have not been sufficiently described: the more obvious ones seldom present themselves to the surgeon, as they are generally fatal,

* Lib. vii. cap. xxxiii.

and the less urgent ones are frequently neglected until it is too late. The mode of its performance has not been sufficiently attended to, and the difficulties and dangers accompanying it are so magnified, as to appal most surgeons, who have not made the operation an object of their particular attention.

The Royal Academy of Surgery, in France, made this operation the subject of their prize question for the year 1757; but, not considering any of the twelve memoirs they received sufficiently satisfactory, they proposed it again for the year 1759, when forty-four were transmitted for the double prize. In the various discussions which took place, during the consideration of these memoirs, references were made to the registers of the academy, which stated, that, on the 3d of March 1739, the reading of a memoir was begun on this opperation by M. Volher, Surgeon Major to the Horse Guards of the King of Denmark, and finished on the 17th; and that on the 24th the reading of another memoir on the same subject, by M. Puthod, Surgeon at Nyon, in the canton of Berne, in Switzerland, took place, was continued on the 2d of April, and finished on the 7th of the same month. Messrs. Le Dran and Guerin, jun. were appointed to examine these memoirs, and their decision was not precipitately formed, as they did not report upon them until the 26th of July 1740, fifteen months afterwards, and their opinion was favourable to the authors. The experiments made by these gentlemen, in the course of their examination, are detailed in a thesis, maintained in the school of medicine, at Paris, on the 7th of March 1748, by M. l'Alouette, which is printed in Haller's "Disputationes Chirurgicæ Selectæ," vol. v, page 265, and entitled, "An femur in cavitate cotyloidea aliquando amputandum?" The memoirs of Messrs. Volher and Puthod are to be found in the "Opuscules de Chirurgie" of Morand.

Besides these memoirs presented to the academy, two others were published at Paris, one by M. Goursaud in 1758, which contained a proposal of a new method for performing

the operation, and the second a laboured and well-digested essay by M. Moublet, inserted in the Journal de Médecine for the year 1759.

The academy decided on the propriety and necessity of the operation, in awarding the double prize to M. Barbet, whose memoir is printed in the ninth volume of the Memoirs of the Academy, duodecimo edition; Paris, 1778. He therein relates the following case as the first on record of the kind. "In the winter of 1748, a boy, about thirteen or fourteen years of age, was brought to the Hotel Dieu of Orleans, suffering from gangrene, in consequence of having eaten unsound rye; the disease being endemic among the inhabitants of Sologne, in rainy seasons, which corrupt the grain of that province. The gangrene had affected both legs and a part of the thighs, and M. la Croix, the principal surgeon of the hospital, endeavoured in vain to arrest its progress by the means usually employed in such cases. The disease extended on the right side to the articulation of the thigh with the hip, and on the left side to the great trochanter. Sphacelus having soon supervened, the death of the boy was considered inevitable in a very short time; but it did not immediately take place, the line of separation between the dead and living parts soon formed on the right side around the joint, and the separation of the thigh at the articulation with the hip was nearly effected by the efforts of nature alone. The head of the femur slipped out of the acetabulum, and was attached to the os innominatum by the round ligament only; and the soft parts of the thigh to the body, by the great sciatic nerve. Under these circumstances, M. la Croix, in the presence of M. le Blanc, by dividing these parts with the scissors, completed what nature alone had almost entirely accomplished. The patient was so well on the fourth day, that M. la Croix proposed to amputate the other leg, the separation of the dead from the living parts having left a space sufficient to allow of his sawing the bone close to the sound parts; and in this

manner these two amputations were done without pain or loss of blood. The boy passed the first two days very well, the wound looked healthy, and some granulations were already perceivable in the cavity of the joint. The second amputation was also in a tolerably good state, and some hopes were entertained of the patient's recovery, when he was unfortunately attacked with fever, of which he died fifteen days after the first operation."

Dr. Kerr, of Northampton, published the following case in the Edinburgh Medical and Philosophical Commentaries for 1779.

"A girl, between eleven and twelve years of age, was brought into the hospital, from Kettering, in December last. She had a tumour on the outside of her right thigh, extending from the middle to near the great trochanter; she was very much emaciated, had a constant cough, night sweats, and many more hectic symptoms. She told us that she had been ailing upwards of two years, during which period she had frequently had fevers, and that her lameness had been gradually increasing from her first illness; that at first she had little pain, but a few months before she came into the house it became very acute, from the groin all round the hip, and till then she never observed the tumour before mentioned.

"She suffered great pain upon the least motion of the joint, and upon every such attempt there was a very perceptible grating to be felt. Being engaged myself, I directed Mr. Warden, house surgeon, to open the tumour the day after she came into the hospital; there was discharged about half a pint of ill-conditioned matter, and we had the same kind of discharge in very great quantity, at every dressing, from that time till the operation, which was performed the Saturday following.

"Flattering myself that the hectic symptoms might be the effects of absorption, convinced that the joint was diseased, and concluding, therefore, that there was no other

method of cure but by amputating the limb at the articulation, I set about it in the following manner:

"Having laid the patient on the sound side, upon a table of a common height, and putting the diseased thigh at right angles with the trunk, I began my incision immediately behind the top of the great trochanter, carrying it obliquely backwards and downwards, to the inside of the thigh, and from thence obliquely upwards, to within two inches of the crural artery. I then began the second incision at the same place with the former, carrying it in an opposite direction over the upper extremity of the trochanter, and from thence obliquely forwards and downwards, to within the same distance of the vessel as in the former.

"These incisions were made only through the skin and fat, which being well drawn back by my two assistants, I cut down into the joint, and from these carried two other incisions through the muscles in the same order and direction, and to the same extent, as those which were made through the outer integuments.

"I then turned the head of the femur out of the acetabulum, that I might with more ease and security accomplish the most important part of the operation, namely, the taking up the artery. From the foregoing description you will easily conceive, that a flap, about four inches in breadth, consisting of all the integuments, with the artery included, was still undivided. This flap I grasped firmly betwixt the fingers and thumb of my left hand (my fingers on the skin side of it, and my thumb on the muscular), and cut it through immediately below my hand, and between three and four inches from the passage of the artery under the ligamentum Fallopii.

"The incision here was made from above downwards, first through the muscular parts of the flap, and then through the fat, vessels, and skin. It was done in this manner, that the skin might correspond with that which was divided by the first incisions, and that the edges of the wound, we cannot say stump, might thereby be kept neat and uniform.

" The next step was to secure the artery, which I effected by passing a strong ligature round it with a needle, and getting one of my assistants to tie it up; such a compression being all the while made upon it by my left hand, in the manner related above, as to prevent the loss of a single drop of blood, and the hæmorrhage from the other arteries was full as inconsiderable as in any other amputation of the thigh. By saving a good portion of the skin, the wound was much more decent and seemly than you can well imagine; but, to my great mortification, I found not only the acetabulum carious, but also the adjacent parts of the ossa innominata to a very considerable extent. From her almost constant cough, I was under the greatest apprehension that the artery would be forced open; yet no mischief ensued, and the ligature fell off at the fourth or fifth dressing; the aspect of the sore, in the mean while, giving us the most sanguine hopes of her recovery. But about the tenth or eleventh day, her respiration became more difficult, expectoration ceased, her mouth and tongue were covered with aphthæ, and she died on the eighteenth day from the operation. The appearance of the sore, even to the last, was such as to afford good reason to suppose that the immediate cause of death was the daily increase of the hectic symptoms, and that without these the operation would have succeeded; I therefore had her opened, and our supposition was, I think, pretty strongly confirmed by the following phenomena. The lungs were almost totally reduced to matter, especially on the right side, in which there was scarcely a vestige of pulmonary substance remaining. The left lobe also was full of abscesses, and reduced to less than half the natural size. An abscess (commonly called the psoas abscess) was likewise found on the right side, in the abdomen, which communicated, by a corroded opening within the acetabulum, with the joint.

" With regard to the expediency of the operation, I am so much convinced of it, in certain cases, that in such I shall not for the future hesitate to perform it when they occur."

M. Percy has not noticed this operation in his work on Military Surgery. M. Larrey has performed it seven times; three cases are related in the 2d volume of his Memoirs, page 180.

In the first case, the operation was performed without accident, and the soldier was so easy for some hours, that a favourable result might have been expected, if he had not been obliged to undergo a hurried journey of twenty-four hours' duration, in the winter season; which, with the fatigue and inconvenience of the conveyance, most probably caused his death.

The second case, the Baron says, "was of an officer, Mons. Bonhommé, of the 18th demi-brigade, wounded by a splinter of a shell at St. Jean d'Acre, and brought to me with an enormous wound of the right thigh.

"The muscles were either torn or carried away from a great part of the circumference of the thigh, the femoral artery was torn about five or six fingers' breadth below the crural arch, and the femur was broken as high as the great trochanter. He had lost a considerable quantity of blood, and was very much weakened. I even thought he would die in a few minutes, if the removal of the thigh was not immediately accomplished. He passed the day and night after the operation in as quiet a state as could be desired. I gave him some antispasmodic draughts, some cooling drinks, and weak broth with a little wine. The next morning the dressings were wet with a reddish-coloured serous discharge, without swelling, pain, or tension in the stump. He was easy during the night, and slept well for three hours. The third day the dressings were removed, and he passed the day very well; the bowels were regular, and he had a desire to eat. I gave him some rice gruel (pottage) night and morning. On the night of the third to the fourth day, he had some slight febrile symptoms, accompanied by throbbing in the stump, and general heat of the body, which was succeeded by a plentiful perspiration, ease, and sleep. In the morning I found the dressings soaked

with a purulent discharge. The flaps had already united the half of their extent, leaving at their upper and under extremities an opening about two inches long, where I had brought out the ligatures. On the fifth day every thing appeared to be going on as well as possible. The matter discharged from the upper and lower openings was of good quality and quantity. On the sixth day his situation was still very favourable, and I had every reason to expect a cure; but the crowded state of our hospital, and the impossibility of separating even the most severe cases of wounded from the other sick, were the cause of an unfortunate occurrence the next night, which the particular nature of our situation did not enable me to guard against. A soldier, affected with the plague for some days, which he had concealed, was wounded in the leg by a cannon-shot whilst on his way from the camp to the hospital. Although very ill with the plague, he was, in consequence of this accident, placed, without my knowledge, amongst the wounded, by the side and on the same straw as this officer, to whom he communicated the plague, which appeared on the night of the sixth and seventh day. In the morning the stump was in a gangrenous state, and its progress was so rapid, that death in a short time destroyed all the hopes I had entertained from the favourable state of my patient the day before.

"The subject of the third case was a drummer of the second demi-brigade of light infantry, twenty years of age. He had his right thigh carried away at its middle by a splinter of a shell at the last assault of Acre. The fracture of the femur extended as far as the joint, and the soft parts were bruised and disorganized. This man, although very much weakened by the loss of blood at the moment of injury, felt excessive pain, which he expressed by the most frightful screams. I immediately amputated the thigh, after my usual method. This young man being stouter than the other, I thought it necessary to retain the flaps in their places by sutures at proper distances. Some long compresses, in the form of a Malta cross, were laid on the stump, and the whole

retained by an appropriate bandage. The operation was very quickly done, and without loss of blood. In a few minutes he became easy, and slept quietly for some hours. The return of the army to Egypt, which took place immediately afterwards, obliged me to move this young man, with the other wounded; and I subsequently learned that he died on the road."

In the third volume, page 349, the two following cases are related. Speaking of the battle of Wagram, he says—"Before night, near five hundred wounded collected at my station, principally by cannon-shot, or having very severe wounds that required some capital operations. This afforded me another opportunity of convincing myself of the necessity of immediate amputation, in all cases where it is declared indispensable; and I have no hesitation in asserting, that if it had not been done, the greater part of these men would have died within the first twenty-four hours; as was exemplified in the cases of two of the Imperial guard, whose wounds rendered amputation at the hip-joint necessary, and who lost their lives in consequence of the operation being too long delayed.

"I must confess, that the little encouragement given me by professional men, to expect success in this operation, made me for a time give up the idea I had entertained of performing it upon these men, although I had met with considerable success in other instances nearly analogous. I had not an idea of saving them, and merely laid some simple dressings on their wounds, which were very extensive, with fracture of the bone to the great trochanter, and then proceeded to perform such other operations as could be done with more chance of success. These two men in the mean time underwent the most horrible sufferings; they begged for relief by the operation, and even endeavoured to destroy themselves. The repeated solicitations of my colleagues, and the dreadful situation of these poor men, at last determined me to perform the operation, although I did it with regret, foreseeing but little hope of success. They had now been wounded seven hours, and

in performing the operation. I had no other object but by removing the cause to alleviate their sufferings, and to take from the sight of their comrades so horrible a spectacle.

" I first, after my method, tied the femoral artery, and the limb was then removed in about fourteen or fifteen seconds. The vessels were very quickly secured, there was no hæmorrhage, and they both became so much more easy, that one man shortly fell asleep. The pulse of the first was scarcely perceptible, his strength was exhausted, and he died three hours afterwards. The other passed the night tolerably well, but continued in a very exhausted state. I saw him at four o'clock in the morning, when I left the hospital to obtain a little repose; and on my return at six, I found him dead."

At page 351, he says in continuation, " I believe, that if an expert surgeon had the boldness to perform this operation, in such cases as require it, immediately after the accident, as in the two cases above related, it would succeed in proportion in the same manner as the amputation at the shoulder-joint. Before the present war, two or three cases only of the operation at the shoulder-joint could be adduced that were attended with complete success; and this arose, without doubt, from the delay in executing them; for, when the operation is indispensably necessary, and is delayed only for a few hours, the wounded are generally lost before they can be removed from the field of battle."

The Baron Larrey performed this operation twice during the campaign in Russia; in the first case, on a Russian soldier at Witepsk, who bore the operation with great courage. Every thing went on favourably until the 25th day. Suppuration had been established. The ligatures had come away from the 7th to the 11th day. Cicatrization had even proceeded to some extent, when provisions became scarce in the hospital; he ate some improper food, suffered an attack of fever and dysentery, and died on the 29th day after the operation. The second took place on a French dragoon, after the battle of Mosaizsk, who was subsequently removed to the abbey of

Kolloskoï, and from thence to Witepsk, where he remained under the care of M. Bachelet the surgeon-major of that place, until he was nearly well, a very small portion of the wound remaining to be cicatrized. At Orcha, it is said, he was seen perfectly cured, but he never reached France, and Baron Larrey has not been able to obtain any account of him from that period. It may, he thinks, be considered, and very fairly, as a successful case, although he is aware that the adversaries of the operation will not admit it as such until the man's death be accounted for.

In the 3d vol. of the Bulletin de la Faculté de Médecine, published at Paris in 1812, there is the following case of amputation at the hip-joint, performed by M. Baffos, surgeon (adjoint) to the hospital of the Enfans Malades, and to that of Madame Necker.

" Bartholomew Tallandier, an orphan, seven years of age, of a phlegmatic temperament (d'une constitution lymphatique), was admitted into the hospital for sick children, on the 24th of September, 1811.

" This child had a cicatrix on the joint of the great toe with the first metatarsal bone, the result of a well-cured scrofulous affection.

" There was on the superior, anterior, and external part of the thigh, a smooth hard tumour, without fluctuation or discoloration of the skin; but it could not be ascertained, from himself or others, whether or not it had arisen from any external cause; and I readily perceived that it depended on a disease of the bone, which had made considerable progress. It was in an indolent state on his admission into the hospital, but soon became painful, and particularly at night; he lost his appetite, became feverish, restless, grew thin, &c.

" The tumour increasing in size, and being convinced that nothing could arrest its progress, I proposed to perform a formidable operation, of the dangers of which I was well aware; but which still left me some hope of saving the life of the child, when no other method could preserve him

from horrible sufferings, which a lingering death would but too slowly terminate. The disease occupied more than the upper half of the femur, including the neck of the bone, for the great trochanter was lost in the tumour; and the ease with which I could bend and straighten the thigh, induced me to think that the joint had not participated in the disease.

" Before I determined on performing the operation, I was desirous of having the opinion and assent of the professor to whom I am so much indebted, and for whom I feel a veneration, equalled only by the particular friendship with which he has honoured me for the last fifteen years. I had the patient conveyed to the Hôpital de la Faculté, and M. Antoine Dubois, after having carefully examined him, encouraged me to operate, founding his opinion for the operation on its offering some chance of success from the thinness of the subject, from the ease with which the flow of blood could be suppressed, and from the certainty of taking away the whole of the disease, by removing the thigh at the hip-joint; whilst, on the other hand, if it was left to itself, it must necessarily end in death. The patient was brought back to the Hôpital des Enfans.

" Two or three days afterwards I requested M. le Baron Larrey to give me his opinion; and after an attentive examination of the little sufferer, he did not hesitate in advising the operation.

" I made several trials on the dead body, of the different methods recommended for performing it; and on considering the advantages and inconveniences of each, I selected that of M. Larrey, which he had three or four times executed himself. I made in it, however, one important alteration, that of compressing the artery against the brim of the pelvis, so as not to be obliged to apply the ligature until I had finished the amputation; whilst M. Larrey, according to the advice of Volher and Puthod, begins by laying bare and tying the artery.

" I performed the operation the 3d of January 1812, before

a great number of students, being particularly assisted by my friends Messrs. Danyau and Abraham, whose presence gave me more courage, from the confidence I placed both in their judgment and friendship.

" The patient was placed horizontally on a bed a little raised, with the pelvis brought forwards, the left leg hanging supported by an assistant, the right leg stretched out, and sustained by another.

" M. Danyau, standing on the left side of the patient, compressed the artery with the thumb of the right hand. Holding the thigh with my left hand, I moved it gently backwards and forwards, to enable me to observe the spot nearest to the joint where the knife ought to enter; which having ascertained, I plunged a sharp-pointed straight knife, eight inches long and six or seven lines broad, into the anterior and superior part of the thigh, external to the artery, and brought it out directly opposite behind. I then cut along the bone for the breadth of four fingers, when, turning my knife, I made a horizontal cut, by which I completed the internal flap. M. Danyau grasped this in his hand, and completely commanded the flow of blood. I now exchanged my knife for a straight bistoury, with which, at one stroke, I cut into the capsular ligament and divided the round ligament, luxating at the same time the head of the femur by a strong abduction of the thigh. Resuming my first knife, I carried it behind the head of the bone, and made a horizontal incision outwards, on a level with the top of the trochanter, which completed the external flap. I pulled out the artery with the forceps, and tied it with a double thread, and then secured the lesser arteries that bled in succession; but there were not more than seven or eight requiring the ligature.

" The operation was performed in thirty or forty seconds, not including the time required for securing the vessels; and the quantity of blood lost was supposed to be something less than a porringer full (palette).

" The dressing consisted in the application of a piece of

agaric of oak to the bottom of the wound, in front of the cavity of the joint. The internal flap was laid down upon this agaric, and retained in apposition with the external flap by adhesive plaisters, some charpie, and long compresses, with a simple retaining bandage, which completed the dressing, and the patient was put to bed.

" We wished to examine the amputated limb on the spot, but thinking it would be more useful to the students to make a cast of the diseased bone, M. Pinson had the goodness to promise to do it. I shall deposit these two preparations in the museum of the Faculty, and it will be seen that the disease occupies more than half of the femur, and that the swelling is formed of a homogeneous matter striated in a manner resembling cartilage; in the middle of which, the bone is seen with its outside rough, and studded with bony points. The femur sawed in two in its length, showed nothing particular, with the exception of a diminution in thickness of its external compact bony substance. The head of the bone, the round ligament, and the cotyloid cavity, were perfectly healthy.

" I shall not enter further into the description of this disease; a more correct idea will be obtained of it by examining the two preparations, which will be placed in the museum of the society.

" To judge from the cries of the little patient, he appeared to suffer a good deal during the operation. I ordered him an antispasmodic draught, with some laudanum, of which he took twenty-four drops in the space of fifteen hours. He was in some pain during the first three days, but had little fever.

" On the third day I removed the dressings, and found that the two flaps had remained in apposition. I separated them a little at their lower angle, to enable me to draw out the piece of agaric, which I did with the forceps, without pain or difficulty. I again dressed it with dry lint, and two or three straps of adhesive plaister; suppuration was soon esta-

blished, and continued throughout of a good quality. Some ligatures came away about the eighth or ninth day, and on the twelfth I found that of the femoral artery in the dressings.

"Perhaps it would be proper to add here some reflections on the nature of the disease, the different methods of operating proposed, and upon the circumstances which were more or less favourable to the success of this operation; but I refrain from doing this, because I only had it in contemplation to lay before the society the first case of success of amputation of the thigh at the hip-joint, performed where the limb was entire."

At page 112 there is the following note from M. Baffos, in continuation of the case: "The wound was healed, the health of the child was good, and every thing promised a most satisfactory result; it was even intended to discharge him from the hospital, when about the sixty-third day, pain came on with tension of the belly, loss of appetite, fever, diarrhœa, &c. A short time after the cicatrix ulcerated, opened out, and Tallandier died at the end of the third month after the operation.

"On dissection, nothing worthy of observation was found in the head, thorax, or abdomen. The acetabulum was filled with a reddish cellular membrane, and some soft fleshy granulations, which were very readily and completely removed by the fingers. It had lost nothing of its depth or form, and the cartilage covering it had suffered no evident alteration, except in colour, which was less bright than natural. The bottom of the cavity was irregular, and an opening was perceived in it through which a round-pointed probe penetrated into the substance of the ilium, the whole internal surface of which was carious."

This amputation is of course either primary or secondary; but the nature of the injury or disease differs very much in these two stages; for very few, or none of the cases that render its performance necessary on the field of battle, ever live to the period when secondary amputation is usually recommended.

Wounds demanding amputation of the hip-joint on the field of battle, occur from cannon or grape shot, or the explosion of shells. Few surgeons would think of performing it for a wound by a musket-ball, although cases do happen that require it, and the principal one that will render it necessary, will be a fracture of the head or neck of the bone, with or without a wound of the great vessels, or some other arterial trunk, causing hæmorrhage, and stuffing the thigh with blood. A grape or small cannon shot may strike the fore part of the thigh, and without touching the inguinal artery itself, may, in its passage to the neck of the femur, wound some large arterial branches, causing considerable hæmorrhage: the wound may not be large, and yet the chance of saving the life of the patient will be very small indeed. I recollect two cases of this kind in particular; one after the battle of Vimiera, by a cannon-shot, which proved fatal on the second day after the injury, no one at that time thinking of the amputation at the hip-joint. The other occurred at Salamanca, by a large ball, which shattered the neck of the femur and the body of the bone below. I did not see this person (an officer) for near forty-eight hours after the injury, but was informed, that on his first presentation for assistance, an artery, supposed to be a large branch of the femoral, had thrown out its blood per saltum, and was stopped by pressing some lint on the wound. The limb soon swelled to nearly twice its natural size, with much external inflammation. The patient himself thought his case desperate, as did every one about him, and declared his willingness to submit to any thing that might be proposed; but the time for operating was past, even if any operation could have been agreed upon.

After two months of severe suffering, in which there were even some prospects of life being preserved, this gentleman died. The latter period of the time was passed, however, without any hope of recovery, and surgical aid was given merely with the view of rendering his last moments as easy as

possible. The great strength of constitution shown by him during the whole course of his illness, and his patient endurance of suffering, have always inclined me to think the operation at the hip-joint would have succeeded, if it had been performed shortly after the receipt of the injury.

A shell bursting near a soldier may drive a piece, of an inch in thickness and a pound or two in weight, into the inner part of the thigh, without wounding the femoral artery, yet fracturing the head of the bone: here several large vessels, and perhaps the great sciatic nerve, would be divided, and the only chance of life would be in the immediate removal of the whole. I saw a fatal case of this kind during the siege of Ciudad Rodrigo, in an artillery-man, who lived long enough to show the necessity of performing this operation.

A piece of a shell may strike between the trochanter and the ilium, go through the neck of the bone, and tear its way out below the tuberosity of the ischium, destroying all the parts in its course, without either killing by hæmorrhage, or by the shock of the blow to the constitution. This accident happened to a man of the 40th regiment, at the battle of Salamanca, about four o'clock in the afternoon. He was in a good state to undergo the operation when I saw him next morning, but none of the surgeons present with me would agree to it; all allowed nothing could save the man; and the opinion entertained of the cruelty of the operation, and of its certain failure, prevented its being done. I took him into Salamanca with me, and his appearance for six successive days before he died, made me reproach myself for want of courage, in not contemning any remarks that might be made, on my having undertaken it in opposition to the opinion of my colleagues; and I declined it, not because the general opinion was against it, but in consequence of the little success of one, and of the great success of the other, of the two next cases to be presently related.

When a cannon-shot carries away the thigh above its middle, so as to exclude the more common circular or flap operation close to the trochanter, it is almost always fatal. These accidents generally destroy at once. On the field of battle, I have seen many, having searched particularly for them, but have generally found the men dead, or beyond the reach of surgical aid. I have, however, seen some cases of this nature, in which no attempts were made for the relief of the sufferers, which was neither humanity nor good surgery.

When the femoral artery has been torn by a cannon-shot, there is, at the moment, a great loss of blood, but the patient does not bleed to death, neither does he appear to die ultimately from the effects of the hæmorrhage. I have known several men lose a great quantity of blood from the same vessel without any such effect, and die apparently from the shock to the constitution, which is observable in many cases of amputation of the thigh, where there has been little loss of blood; and yet the patient dies, during, or immediately after the operation. A considerable hæmorrhage, on the other hand, renders a patient less able to bear an operation than he otherwise would do; and where there has been much and sudden bleeding, the powers of life are so exhausted as not to be able to bear any further disturbance. This effect is most frequently caused by wounds of the femoral artery, and where it has occurred, the chance of success from the operation will be very small. The combination of injury arising from the loss of blood and the shock of the blow, will have so much diminished the powers of life, that the operation in addition, will destroy the remainder.

If (as I have seen in many instances) the bones of the pelvis are injured, in any of the preceding kinds of accident, the result will be fatal, and the operation should not be performed; but some little destruction of the soft parts should not prevent it, if the patient be otherwise in a favourable state.

A very extensive injury of the soft parts of the thigh, if

the bone be not broken, and the femoral artery not divided, does not authorise the operation, although the artery be laid bare for three or four inches of its course.

Captain Flack, of the 88th regiment, was wounded in the trenches at the siege of Ciudad Rodrigo, by a twenty-four pound shot, which struck the outside and anterior part of the left thigh, and carried away the fore part of it from the groin to within a hand's breadth of the knee; the femoral artery lay bare at the bottom of the upper part of the wound, the sartorius and rectus muscles were carried away, and all the muscles on the outer and inner side of the thigh more or less mangled or torn by the shot; it was altogether the most frightful looking wound I had seen, not even excepting where a limb had been completely torn off. Having the superintendence of the 3d and 4th divisions of infantry, the greater part of the medical officers of both were with me at the time, and on this officer's being brought to our field hospital in the rear of the trenches, they all, without an exception, declared he must shortly die, if the limb was not removed. In compliance with this opinion, I proposed to tie the artery below Poupart's ligament, and to endeavour to save flaps to cover the great trochanter, sawing off the bone below, as I have since done in several instances; and if this was not practicable, the head of the femur was to be removed. On placing him on the panniers for the purpose of operating, he was so exceedingly faint, the pulse at the wrist being scarcely perceptible, that I conceived the operation would be useless, as he would certainly die under our hands. He was removed to a corner of the hospital, and placed on a hay mat amongst other wounded supposed to be in a dying state, a little lint being laid over this enormous surface. By the next morning he had much recovered, and as his thigh became very painful, he was desired by the surgeons of the division arriving in succession, to wet it with warm water; this was done, but his countenance was so ghastly that he was considered by every one as dying: indeed his regiment actually returned him dead, and his com-

mission was filled up in England. In this state he remained till the day after the storming of Ciudad Rodrigo, when, from the advance of Marshal Marmont, the wounded were sent across the Agueda. Desirous of knowing whether any stragglers of the corps I belonged to might still be at the field hospital, I rode to it on leaving the town, and found every one gone except this poor gentleman, who requested my assistance; I offered to take him to my divisional hospital, five leagues distant, where all the other wounded had been conveyed, which offer he gladly accepted, and reached the village of Aldea del Obispo, with less inconvenience than I expected. I daily feared the femoral artery would give way, but nothing of the kind occurred; the slough from the whole surface of the wound soon separated, and there was much less of it than is usual on such occasions; but this may be attributed in some measure to the attention paid him, and to the extreme coldness of the weather in a room without a fireplace. The discharge of pus was very great, and the artery lay in a channel completely surrounded by it, and to which it communicated its pulsatory motion. I hourly expected it would ulcerate, but granulations soon began to shoot out, and by the end of three weeks the artery was covered in, although its pulsations were still visible at a distance; the sore gradually contracted in a surprising degree, and in two months it was diminished to half its original size, very little new skin having been formed. At this period he left me on his way to the rear, on the army moving down to the siege of Badajos. The attention paid to this officer in regard to diet, attendance, and surgical aid, was very great; more, indeed, than he could have received under any other circumstances. His recovery was considered so unlikely, that no one looked at his wound after the first day; all supposed him past relief, as was really the case with an officer of engineers, lying beside him, whose arm was shattered to pieces by a shell, and the os ilium bared on the outside of the glutæi muscles, and on the inside of the iliacus internus, as if it had been for some time in maceration. The insertions of

the external and internal oblique, and the transversalis muscles were torn out, without the peritoneum being opened, which alone prevented the intestines from coming out at the wound.

Although Captain Flack's life was saved, still I am of opinion that very few would have recovered from such an injury. His greatest inconvenience at present arises from being unable to bend the leg backwards on the thigh.

The secondary operation has seldom, I believe, been performed during the suppurative stage succeeding to injury from gun-shot wounds; and as I do not believe it can be successful, if done at this period, I would not perform it after the second day has elapsed, until the third or fourth week. There are not many cases that will demand it at this period, as the femur, in most compound fractures of the thigh, can in general be sawed off, at, or immediately below the little trochanter.

The following case will best explain another state of disease in which the operation may be necessary.

Private Mason, of the 23d regiment of infantry, or Welch Fusiliers, had his thigh amputated about its middle during the siege of Ciudad Rodrigo, and was sent to the divisional hospital at Aldea del Obispo, with the other wounded of the fourth division, those of the other part of the army being in general hospital. For some time he appeared to be doing well, when the wound became irritable, opened out, and sloughed on the under and inner part, with some hæmorrhage. Attention was paid to this both in dressing and searching for the vessel, which could not be found, for the stump ceased to bleed when opened and cleansed, and yet soon filled after the dressings were applied. Finding my endeavours to suppress the hæmorrhage fruitless, I determined on tying the femoral artery above where the profunda is usually given off, as it appeared to be a branch of that vessel that bled. This was effected, as I supposed, about two inches and a half below Poupart's ligament, with little disturbance to the contiguous parts. The hæmorrhage ceased from the stump, and I hoped all would do well. The next morning the bleeding suddenly

returned, and about a pound of coagulated blood was removed from the stump. Pressure of the artery against the bone hardly commanded it, and the poor man earnestly begged something might be done to save him. The appearance of the stump had deteriorated very much in the last twenty-four hours, the ulceration was extending deeper between the muscles, and the prospect of the healing of the stump without much exfoliation of bone, even if the hæmorrhage could be suppressed, was but trifling. He willingly agreed to have the stump removed a little below the ligature on the artery, although he was aware his chance of surviving it was doubtful: but, finding himself much weakened from the loss of blood, he said to me, "I must die, Sir, to-night, if I keep it, and I will take my chance."

The artery being compressed against the os pubis, I carried my incisions to the bone, taking the ligature on the artery as the centre; and in doing this I observed the profunda, equal in size to the one I had tied, running down a little distance behind and on the outside of it, which I immediately secured. The head of the bone was now removed from the acetabulum without difficulty. Fourteen vessels were tied; yet little blood was lost, as my two assistants, Dr. Cartan, now Physician to the Forces, and Mr. Loane, late surgeon of the 94th, the only professional men present, aided me in pressing on the mouths of the vessels with their fingers, until I could take them up in succession. The parts were brought together, and the integuments retained in contact by two sutures with the needle above and below, assisted by adhesive straps. The operation from first to last was completed in less than a quarter of an hour, and the man bore it heroically. I had even strong hopes of him for the first hour, but he gradually sunk, and died seven hours after the operation.

On examining the original stump, I found the femoral artery perfectly open where the ligature came off, but from this part it never bled. It was from underneath the blood came,

and from some small branches of the profunda. This vessel was given off from the external iliac, or rather the external iliac divided into two equal branches, immediately after giving off the epigastric and circumflex arteries. There was the same peculiarity in the other limb, and the vessel acting as the profunda sunk into the thigh at the usual place. I have always thought this man would have lived if the amputation had been performed when the femoral artery was tied, which operation of course could not succeed, from the peculiarity in the origin of the profunda.

After common amputation at the middle of the thigh, it may be necessary, at some distance of time, in consequence of the injury to the bone having extended above the place at which it was sawed off, or from the death of the bone, in consequence of matter forming on its surface; ulceration then takes place at or about the trochanter, the soft parts all become diseased, the irritation is great, and the patient dies exhausted; and of this I have seen several instances.

The most common cases requiring its performance at a late period, are compound fractures above the middle of the thigh, which have been badly or unsuccessfully treated: in these, the bone, as well as the soft parts, become a mass of disease, or cause such continued pain and irritation to the patient, with a useless limb, and rapidly declining health, that the operation offers the only chance of relief.

"In a skirmish with the enemy, in the mountains near St. Sebastian, August 1813, Sebastian de l'Amour, a corporal in the Chasseurs Britanniques, received a wound in the left lower extremity; the ball entered the upper and outer part of the thigh, passed obliquely downwards and inwards, fractured the os femoris, went through it, and was extracted about the centre of the sartorius muscle, at an opening made with a scalpel. Soon after receiving the wound he was conveyed to the general hospital at Passages, and from thence, in February following, removed to England, arriving in an

extremely low irritable state, a copious discharge issuing from the wounds, and the limb much indurated, but giving, by its firm feel, every reason to believe that it had united.

After some time the deposition of ossific matter was so great, both above and below the fracture, that the thigh became considerably enlarged, the old or original bone had grown carious to a great extent, attended with sinuses in the soft parts running up to the trochanter major, and downwards to the condyles.

July 18. His body being much emaciated and reduced by hectic fever, night sweats, and diarrhœa, the extremities cold and œdematous, appetite gone, and the constitution evidently giving way, a consultation was called of the senior medical officers of the establishment, for the purpose of forming a decisive opinion on the case; when, after mature deliberation, it was determined that the only chance of saving his life was by amputating the limb at the hip-joint (the disease of the femur running up to its very head). However, on the patient being questioned as to submission, an answer was given in the negative, and the idea accordingly, though reluctantly, abandoned.

On the 21st, having agreed to the operation, the symptoms being more favourable, he was placed diagonally on a narrow table, supported by a strong man behind; Dr. Emery commenced the operation by making an incision with a large scalpel through the integuments, beginning four fingers' breadth below the anterior superior spinous process of the ilium, which was carried with the convexity downwards on each side of the thigh, and meeting close to the tuberosity of the ischium: the adipose membrane was then separated from the fascia and drawn upwards; the femoral artery was next laid bare by dissection, and secured below the giving off of the profunda, by passing an eyed probe under it with a double ligature, which being separated, were tied in two knots half an inch asunder, and the vessel divided between them; the vein was also tied, to prevent an effusion of blood from the limb. The

scalpels were now laid aside, and an amputating knife applied close to the retracted edge of the skin, cutting obliquely down through the muscles of the thigh on the fore part and inside. In doing this the patient lost a few ounces of blood, though chiefly from the veins, which, with the arteries then cut, were immediately secured by ligatures. After this the incision round the thigh was finished, by dividing the remaining uncut muscles; which being accomplished, the femur was laid completely bare by dissecting them up with a curved scalpel, first on the outside, entirely above the trochanter major, and then on the inside, till the notch of the acetabulum was rendered perceptible, through which a double-edged bent bistoury was introduced into the capsular ligament, dividing with it also the round ligament, which was made to present itself by turning the limb outwards. The head of the bone was next extracted, the vessels taken up, and the operation finished by removing, with the same bent instrument, as much of the cartilage that lines the cotyloid cavity as could be got at, scarifying what could not be taken easily away, and detaching some ligamentous filaments and synovial apparatus. The wound was then cleansed, brought together in a straight line, and secured by four sutures passed through the cellular substance at equal distances, nearly close to the edges of the skin, supported by strips of sticking plaister, covered with pledgets of lint, common dressings, &c. and the whole made fast by a broad calico bandage, to which a cushion was attached, being fixed so as to press on the parts opposite, with a view of making them fill the cavity caused by the removal of the trochanter major, and act as a prop to the external and inferior side of the stump. He was immediately put to bed, and a draught, composed of forty drops of tincture of opium and spirits of nitre, was given.

July 22. Slept soundly after the operation, and again during the night; pulse 120, rather full; skin rather dry, with increased heat; bowels confined.

24. Has had a good night, and towards morning a lax

motion, pulse 119, skin soft and pleasant to the feel, heat of stump diminished. Removed the dressing, and examined the wound, of which a third of the upper and some of the lower part had united by the first intention, the centre being a little open, and a small quantity of sanious fluid issuing from it. The inferior suture has cut its way out; the application of cold water to be continued.

26. Was very uneasy the early part of the night, but slept well towards morning; has had four evacuations during the last sixteen hours, unattended by griping or pain; pulse 102, and moderately full. He does not look quite so well, and is rather irritable: the discharge from the wound is less on pressure, but more has issued out from under the dressing, since yesterday, than in the same space of time before; granulations springing up, but the inferior part of the line, which appeared united by the first intention, now gapes a little; three ligatures came away, and two sutures were taken out. Continued the cold application to the stump, and allowed him some chicken broth.

℞. Misturæ cretæ..... ℥ viij,
Tincturæ kino ..... ℥ j.
Misce. Sumat uncias duas tertiâ quâque horâ.

July 27. Has had an excellent night, and only one motion; countenance rather brightened, tongue clean and moist, pulse 102 and soft; discharge considerable since yesterday, but good; two more ligatures came away.

29. Appears better, though very irritable; tongue clean and moist; lips not so much parched; wound improved, granulations more florid and healthy; two more ligatures (one of them from the femoral artery) and the remaining suture have come away; discharge rather lessened.

Capiat infusi gentianæ comp. ʒ, Pulv. rhæi gr. iij, secundâ vel tertiâ quâque horâ.

August 1. Ate a good dinner yesterday, and drank some old Port wine; passed a very favourable night; wound appears well, but a considerable quantity of discharge comes away by

pressure from the vicinity of the acetabulum, where it collects in spite of our endeavours to prevent it by compress, bandages, &c. The last ligature came off, though not so easily as the others, having embedded itself in granulations. No motion since the evening; pulse 108.

August 2. Slept well; had two motions during the night; abdomen tense; right extremity cold and œdematous; wound pale and languid; discharge moderate, and but little of it issuing from the cavity of the acetabulum.

Capiat olei ricini ℥ss statim.
Liniment. anodynum cum camphorâ.

3. Rested well during the night; had three motions after taking the castor oil; wound improved in appearance, but discharges considerably; a small quantity of good pus isued out when dressing, from an orifice formed at the superior part of the line; œdema of the right leg and foot abated.

Repetatur infus. gentianæ ut antea.
Extr. opii gr. ij hora somni.

5. Slept tolerably well; has been a little purged in the night; complains of tenesmus and tension of the abdomen; pulse 120, and weak; could eat no breakfast, is extremely irritable, obstinate, and cross; wound looks well; discharge small, but not very good.

℞. Olei ricini..... ..... ℥ j,
Tinct. opii..... m. xxx,
Aq. pimentæ..... ℥ j.
Fiat haustus statim sumendus.

6. Passed an easy night, though with little sleep; had two motions towards morning; pulse 112, and stronger; wound looking healthy, but discharged on dressing a considerable quantity of thin fluid; ate some chocolate for breakfast, and is improved; directed some tincture of kino to be given in his wine, as he refuses to take medicines.

7. Slept tolerably well till six o'clock, when he was disturbed by spasms and darting pains in the inferior part of the wound, and soon after the bandage became tinged with blood

to a considerable extent; compresses of linen wetted with vinegar and spirits were immediately applied, and continued until ten o'clock in the morning, when the dressings were renewed; but the bleeding had ceased, and its source could not be discovered, or the quantity of blood lost be ascertained; I think it did not exceed four or five ounces; the wound did not look badly, though the stump appeared and felt swollen; the granulations were pale and languid without much discharge; fresh dressings were now applied with only a wet pad over them, the bandage being dispensed with: pulse 112, and pretty good.

℞. Infus. rosæ.. ..... lb. j,
Acid. sulph. .... ʒss.
Misce.

Fiat mistura cujus capiat æger cochlearia iij ampla quartis horis.

8. Has had an excellent night, with three evacuations; pulse 112, and weak; wound looks languid and pale; discharge profuse, mixed with coagulated blood, issuing chiefly from the neighbourhood of the acetabulum; he is not quite so irritable, and appears somewhat better.

10. Although he has slept well, and is free from pain, yet he is excessively irritable, cross, and obstinate, refusing nourishment, wine, and medicine; pulse 112, weak and fluctuating; countenance pale and thin; wound not looking so well, and discharging very considerably.

12. Bowels getting into good order; passed a comfortable night, and is in much better humour; says he shall get well; afforded considerable assistance in dressing the wound, which appears more florid and healthy, but discharges profusely. Repetatur infus. rosæ, ut antea.

13. Having eaten a little fish for dinner, he became sick in the evening, and vomited, but rested well all night; has taken some of his medicine, and positively refuses swallowing any more; discharge from the wound rather increased; granulations requiring caustic.

14. Much better, passed a good night, and was only twice

purged; pulse 106, and improved; edges of the wound healing fast, granulations rather exuberant; made a good breakfast with chocolate, and at his own request was placed in an erect position.

15. Had three loose motions during the night, but nevertheless rested well; pulse 120, and inclined to waver; countenance not quite so cheerful, wound healing, discharge diminished.

16. Slept well till break of day, since which he has had four evacuations, and is now easy and comfortable; abdomen softer; pulse 111, and rather more regular; wound healthy, and discharging but little.

Extr. opii. gr. ij, omni nocte.

17. Had two loose stools since evening; ate some breakfast, but vomited it up again with a quantity of bile; spirits much depressed, and he is become more irritable, looking pale and emaciated: pulse 100, and soft; wound florid; discharge profuse and excessively thin.

18. Has had but little sleep, being extremely restless all night, and is now in an extremely low and debilitated state; pulse 106, and very weak. At seven this morning the bandages, pads, &c. were perceived to be soaked in blood, and were immediately wetted with vinegar, and compressed by the hand of one of the assistants for about two hours, when the dressings were removed; but the hæmorrhage had ceased, and no trace or sign could be discovered to guide us to the vessel from whence it had taken place. The stump was found much tumefied and hard, though in other respects looking well; fresh lint, sticking plaister, and a pad, were applied without a bandage, and an orderly directed never to quit the bedside, but to keep the whole wet and cold, with a lotion composed of the superacetate of lead, spirits of wine, and vinegar. His spirits have entirely forsaken him; he has given up all idea of living; feels disgusted with every body and every thing, and wishes to have a priest sent for; the

quantity of arterial blood lost on this ocasion was, I imagine, about three or four ounces.

19. Has been composed and comfortable all night, sleeping at intervals, and is certainly improved; pulse 90, and stronger; abdomen soft and flaccid; no motion the last thirty-six hours; wound discharges copiously a thin sanious fluid, mixed with coagulated blood; the tumefaction of the stump somewhat diminished; took some chocolate for breakfast.

20th. At three p. m. he died.

Dissection.

"On making an incision the whole length of the cicatrix, and down to the acetabulum, the parts exhibited a variegated appearance, having a white spot near the centre, the shape and size of an acorn, with the consistence of tendon; a sinus ran down to the edge of the sacrum, being, together with the acetabulum, filled with a sanious fetid fluid; another sinus also extended about an inch and a half in the course of the femoral artery towards the groin, on the superior side of the wound: the edges of the acetabulum had a rough feel, and were denuded of their cartilaginous covering; when making the incision the knife conveyed the same sensation as is experienced on cutting an apple, and indeed such was the case when performing the operation. On laying open the abdomen, the liver was found considerably enlarged, weighing nearly seven pounds; externally, of the colour of straw, and appearing internally as if parboiled, bearing also evident marks of having been injured by the immoderate use of spirits; the pressure of it against the ribs had been so great, from its enormous size, as to cause the formation of regular grooves. The cardiac orifice and extremity of the stomach bore signs of inflammation, as did the jejunum and part of the ileum. In the thorax were found such firm adhesions of the lungs to the pleura, that they could not be separated without lacerating and tearing them to pieces. The other viscera were in a

healthy state. The orifice of the vessel from whence the hæmorrhage came could not be discovered."

Mr. Brownrigg, Surgeon to the Forces, has performed the operation three times: on one occasion the patient lived eight days, and died from fever, supposed to arise from causes foreign to the operation.

In the last case he was completely successful. The man received a gun-shot wound in the thigh, which fractured the bone close to the trochanter, on the 29th December 1811, near Merida, in Spain. On the 12th of December 1812, the operation was performed, and the man is now at Spalding, in Lincolnshire, in perfect health.

After the battle of Waterloo, I performed the operation, successfully, on a French soldier, who had been left for several days on the field of battle, without surgical aid or sustenance. I remained at Brussels but three days afterwards, and I am indebted to Mr. Campbell, Deputy Inspector of Hospitals, under whose care he was, for the following particulars. In making my own acknowledgments to him, it is proper to say, that without his unremitting kindness and attention the man could not have recovered, and that the public is indebted to him, in a much greater degree than if the operation had been his own.

"François de Gay, private in the 45th regiment of French infantry, was wounded, at the battle of Waterloo, by a musket-ball, which entered behind, fractured the neck of the femur, and made its exit anteriorly, about four inches below the groin. He was admitted into the Elizabeth Hospital on the 5th of July, much exhausted, not having had until that period any regular attendance. In addition to his wounds, which had put on a sloughing appearance, he suffered from an extensive sore on the sacrum, which was caused by lying on the wet ground for five days. The wounds being cleansed, and the thigh placed in proper position, he remained until the 7th, when the operation of amputation at the hip-joint

was considered advisable. This operation was performed by Mr. Guthrie at two o'clock of the 7th: nineteen days after the injury. His pulse was 120; and a considerable deviation was observed by Dr. Hennen and Mr. Collier, between the pulse at the wrist and at the groin, at the termination of the operation; his spirits good; he lost about twenty-four ounces of blood; was immediately put to bed, and had an anodyne draught. In the evening his pulse was only 108; had lemonade for common drink.

8th. Had milk for breakfast; beef tea for dinner. Evening, pulse 124.

9th. Pulse 120, and soft; skin cool; countenance good; stump discharging good pus, and in one part a quantity of sanies. No particular appearance of inflammation or any thing unfavourable.

10th. Pulse 108, good; skin rather hot; countenance not so good as yesterday: the wound discharging healthy pus in great quantity, especially from the centre, where there was considerable loss of substance: he was sponged all over frequently with vinegar and water; had some chicken broth and wine.

11th. Pulse 112; skin and bowels open; slept four hours during the night.

12th. Discharge lessened; skin rather hot; bowels open; pulse 110: the bed-sore on the sacrum is sloughing, and obliges him to rest on one side; the stump is healing at the sides; the integuments on the fore part have contracted considerably towards the ileum; he is still supported with wine, chicken broth, tea, &c.

13th. Pulse 104, and good; discharge increasing; the external appearance of the stump healthy; he is rather irritable; bowels and skin open; the bed-sore enlarging; had an anodyne at night, with sago and claret.

14th. Slept well; skin hot and dry; he is a little purged; countenance not so good; discharge much less than yesterday; pulse 120, after dressing; bed-sore still enlarging; dressed

with spirit. terebinthinæ. The body frequently sponged with vinegar and water during the day. A pill composed of calomel gr. iij, pulv. antimon. gr. ij, was ordered, and an anodyne at night.

15th. Slept well; had a copious perspiration in the night; bowels perfectly open; discharge less, and of good quality; bed-sore looks healthy, and is dressed with the spirit. terebinthinæ. Pulse this morning, after dressing, 108.

16th. Countenance improving; no headache; bowels open; tongue clean: pulse 112, and good. The stump is looking well, and the discharge is not considerable; skin rather hot.

17th. No change whatever; his body was sponged as before, frequently in the day.

18th. Discharge decreasing; general health improving; the bed-sore is looking healthy, but is very extensive. The dressing and nutriment continued.

19th. Health improving; the stump and bed-sore look healthy. Was visited by the Baron Larrey, who had been wounded and taken prisoner by the Prussians.

20th. Slept well; granulations look healthy; the discharge more copious, but of good consistence; bowels and skin open; general appearance good and tranquil; pulse 104; dressings, &c. continued.

26th. No remarkable change since last report, either as to the discharge of the sores, or general health.

27th. Passed a restless night; pulse feeble and 108; discharge considerably increased, but of good quality; granulations looking healthy; bed-sore clean; countenance sallow, eyes suffused; bowels gently opened by castor oil, and had good broths, jellies, and wine, in the course of the day; dressing, &c. continued.

28th. Slept a little during the night; pulse after dressing 130, small and feeble: countenance as yesterday; bowels and skin open, and head clear. In the course of an hour after dressing the pulse came down to 110, but still feeble: broths, jellies, and wine continued.

30th. No material change in the discharge; general health and pulse somewhat improved; same treatment continued.

31st. Slept badly; pulse 120, and small; tongue somewhat furred; countenance sallow; eyes suffused; appetite bad; had a dose of ol. ricini this morning; broths, &c. continued.

August 1st. Pulse 120; countenance improved; had several stools during yesterday and last night, which were not very fetid; the discharge from the stump this morning is not so considerable; appetite somewhat improved; the bed-sore still enlarging but looking healthy; it is dressed with diluted nitric acid; nourishing broths, &c. continued.

2d. Slept well, and feels himself much better; discharge less and good; skin and bowels open; pulse 110; usual diet, &c. continued.

4th to 20th. No material change has taken place; his general health has been gradually improving; the sore and discharge lessening; during this period he took the following mixture, from which he appeared to derive benefit:

Infus. gentianæ et cinchonæ, ana ..... ℥ viij,
Acid. sulph. dil. .... ʒ ij.
M. Capiat ℥i 3ti horis.

His appetite was, in every instance, studied, and even solicited by cordial and nourishing diets.

20th. Had a bad night; slept little; bowels constipated; sores looking well and healthy; had castor oil; diet, &c. continued.

21st. Passed a good night; had several motions yesterday; discharge good; pulse 104; skin open; head clear; countenance considerably improved; appetite very good.

22d. No alteration as to general health; matter appears to be forming under the glutæi muscles, communicating with the original wound of the ball.

30th. General health still continues good. Hitherto the matter from the abscess was discharged through the original wound, but, apprehensive of its extension, an opening was

made through the glutæi muscles, and the abscess dressed from the bottom.

September 1st. General health still improving. The discharge from the abscess healthy and diminished; feels heat about its edges; bed-sore looking well, and its circumference diminished; the surface of the stump lessening; discharge healthy, the portion of the ligamentous edge of the acetabulum, which had not hitherto sloughed away, came away this morning: the ligatures would appear to have been thrown off with the discharge.

2d. A small abscess appears to be formed over the external iliac artery, communicating with the stump; the discharge from it is good: the granulations on the surface of the stump do not appear so florid as yesterday, nor is his countenance as good; pulse 108, and full; his skin is hot; tongue moist and white.

℞. Hyd. submuriat..... gr. ij,
Pulv. rhæi..... gr. xv.
Confect. aromat. q. s. ut fiat bolus statim sumendus.

Vespere. Has had three motions since taking the medicine; thinks he is better, and has had some sleep since its operation: his pulse is now 110; feels as if he would be again purged. A little jelly, tea, &c. ordered for the night.

℞. Extract cinchonæ, extract. gentian..... ana ʒ j,
Olei cinnam..... gtt. x.
M. fiant pil. xxiv; capiat ij ter in die.

3d. Has had a good night; had one alvine evacuation early this morning; pulse 110; measures taken by compress to obliterate the abscess over the iliac artery; his tongue is clean and moist; the granulations as yesterday; chicken broth, &c. to be given.

4th. Has slept well; complains of tension of the abdomen, although his bowels are open; no alteration in the appearance of the stump or bed-sore; the general health is somewhat better, and his appetite is returning. Pulse 112.

6th. Slept well, and is perfectly tranquil; the abscess over

the iliac artery is diminished in size, about two ounces of arterial blood was discharged from it to day; the abscess, which was under the glutæi muscles, is nearly obliterated; the bed-sore is stationary. Continue the pills. Pulse 109.

7th. Was attacked during the night with diarrhœa, which is very troublesome; in other respects the same as yesterday. Pulse 116. Repetatur bolus ex rhæo et hyd. submuriat. He is supported with cordials, nourishing broths, &c.

8th. The purging continues, but not so harassing; granulations appear at the bottom of the acetabulum, which are florid; the remaining surface looks pale, and the discharge thin. Pulse 110. Repetatur bolus.

9th. Has had a very good night; feels himself much better, and demands food; the surface of the stump looks better; the abscess much diminished, and no more arterial bleeding. Pulse 106. Three thin alvine evacuations during the night.

11th. Health mending gradually; wound closing in; the granulations in the acetabulum luxuriant and florid; the abscess much less than yesterday; no alteration in the bed-sore; bowels regular. Nourishing diet, broths, &c. continued as before the attack.

15th. Pulse generally from 104 to 112; improving rapidly in every respect; the diet is well regulated, and continued as usual.

16th. Did not sleep well; finds himself, however, strong and in good spirits; had three evacuations since yesterday; the stump and abscess doing well. Pulse remaining at 106; apprehensive of accumulation, the laxative bolus was repeated.

18th. The acetabulum is nearly three parts full of healthy granulations; the stump and abscess closing, and the health good. Repetatur pil. ex gentianâ et cinchon.

23d. He is gaining strength; slept well; the bed-sore looks more irritated in consequence of his constantly remaining on his back; has been detained by force for four hours on his

side, but more was lost from the general irritation caused by this plan, than gained in the appearance of the sore.

24th. Still mending; had him placed at the window, and supported by six men for an hour and a half, which he bore very well, and appeared to acquire additional strength by it; bowels regular, and appetite good.

25th. Is perfectly tranquil; has slept well, and talks with confidence of his recovery; his bowels are regular, skin moist and soft; is free from all pain; stump, &c. are doing well; was supported at the window for the same period as yesterday; he did not however bear it so well, some debility supervening; in all other respects he continues to promise a favourable issue: had him changed to his own room again in the evening.

27th. Slept but little in consequence of an attack of diarrhœa, which is attributed to a salad he ate yesterday; his countenance is not so lively; pulse 116, and irritable; he is careless as to food.

℞. Pulv. rhæi ..... gr. xxx,
Pulv. cinnamoni..... .... gr. xv.
M. Divide in chartulas iij, quarum sumat j ter in die.

28th. Had some sleep during the night, but feels himself not so well this morning; he is griped a little, and has no inclination to eat; his pulse is 120; the wound does not look so healthy as yesterday.

℞. Olei ricini ..... ʒ iv,
Aq. cinnam. ..... ℥ j,
Tinct. opii ..... gtt. xx.
M. et ft. haustus statim sumendus.

29th. Had a tolerably good night; bowels getting more regular; countenance better; the surface of the wound is now only 2½ inches by 1½.

October 1st. Every thing going on apparently well; appetite good; sores healing.

5th. Slept very well: there is an anasarcous appearance

of the scrotum this morning; his bowels slightly affected during the night, otherwise doing very well.

℞. Decoct. cinchon..... ℥ x,
Acid. sulph. dil. ..... ʒ jss.
M. Capiat ℥ss, tertiis horis.

8th. Had four alvine evacuations last night; tongue clean; pulse 100; the wound, &c. look well; there is a slight œdematous enlargement of the limb; it is carefully rolled up with a flannel bandage; the acetabulum is now completely filled up, and on a level with the general surface of the wound; the anasarcous swelling of the scrotum begins to disappear; his appetite continues good. Repetatur decoct. cinchon.

9th. The state of the bowels much better; the œdematous appearance of the limb does not increase; the bandage continued, and frequent friction with flannel and volatile liniment. Repetatur decoct. cinchon.

10th to 15th. No alteration in the appearance of the extremity; his bowels are regular, and his appetite good; tongue clean; pulse from 104 to 110 during this period. His medicine agrees with him, and he is in good spirits.

17th to 22d. The wound nearly closed, and the abscess is totally obliterated; pulse 110; bowels open; skin cool, and head free; has a good appetite; is nourished with sago, wine, broths, tea, &c.; complains of no pain; the swelling of the extremity is subsiding.

25th. Had some sleep during the night, but complains of much pain in his knee; the limb is much diminished this morning; has had two alvine evacuations during the night; has passed a considerable quantity of water during the last twenty-four hours; tongue clean; head clear; skin cool; pulse 120. Had a mutton-chop for breakfast; is in good spirits. Repetatur decoct. cinchonæ. Chicken broth, beef tea, &c.; one bottle of porter, one pint of port wine; the limb to be frequently rubbed with flannel and volatile liniment.

27th. Was removed to a more airy room; he had several

alvine evacuations during yesterday and last night, which prevented his sleeping; no change in the appearance of the wound or bed-sore; he is much more irritable; pulse 130, and feeble; skin hot and dry; the œdematous swelling of the limb remains much the same; the friction with volatile liniment to be repeated; the body to be sponged with vinegar and water; to have jelly and white wine, broths, &c. Laxative bolus repeated.

28th. Slept well, and feels in every respect better; is anxious to eat.

November 1st. Feels himself quite well; his bowels are regular, and appetite good.

11th. It would appear that matter is again forming under the glutæi muscles; in all other respects doing well.

12th. Complains of pain in the direction of the former abscess; is otherwise very well.

13th. The cicatrix of the glutæal abscess opened spontaneously this morning; he is in other respects doing well.

14th. The discharge from the abscess is very trifling; the bed-sore looking healthy, and healing.

19th. During this period he has been sitting up before the fire two hours each day. There is no discharge from the abscess; his appetite continues good, and is gaining strength; the unhealed part of the wound is not quite an inch in size."

At this period he was brought to England by Mr. Campbell, and sent to the York Hospital, where the remaining sore healed without inconvenience. His Royal Highness the Duke of York, on seeing the man, was pleased to interest himself in his favour with the French Government, and on his return to France he was placed in the Hotel des Invalides, where he now is. The plate is an exact representation of the part, taken from a drawing made in 1823. He is capable of walking as much as three miles at a time, the wooden leg which he has attached to his body being thrown forwards by an exertion of the muscles of the trunk. He is in very good health, not quite so fat as when in England,

talks of getting married, and is not, as the French express it, "*sage.*"

The operation was also performed by Dr. Cole, on the 6th of April 1814, after the unsuccessful attack on Bergen-op-Zoom, in consequence of fracture of the femur at its upper extremity. The patient was in a bad state, and survived only twenty hours, although the operation was performed with great dexterity and with little loss of blood.

Another was done by Dr. Blicke, at Antwerp, after the battle of Waterloo. This patient, according to the report of the Medical Board, of which Dr. Cole was president, was in a very bad state, and the operation was only agreed to by the gentlemen composing it, as offering a slight, although the only chance for life. The patient survived it eight days.

The operation has since that period been done in three or four different instances unsuccessfully. Mr. Orton, surgeon of Kegworth in Lincolnshire, has succeeded, however, in one case; and it is a great satisfaction to me to think that he was stimulated to its performance from having read my observations on the subject. He performed the operation in June, 1824, on a patient suffering from disease of the knee-joint and thigh-bone in its whole length, with abscesses extending up to the dorsum of the ileum. It was successful: the patient left Kegworth on the 28th of the following August, and was quite well on the 10th of September, being fatter and heavier than at any previous period of his life.

These cases prove, that the operation is not only necessary, but practicable, and that it may be effected with success under certain circumstances. This being granted, it necessarily follows, that the operation ought to be recommended and performed in every case in which it can alone bring relief, or offer a prospect of success. No man should therefore be allowed to die without its being proposed to him; and if it be a case for primary operation, the sooner it is done on the field of battle, consistent with propriety, the greater will be the chance of success, for the patient cannot live to the pe-

riod for secondary amputation. It is in this, and other operations high in the thigh, that the question of time is most important, for haste is as injurious as delay, when improperly applied.

If the patient has suffered much loss of blood, or is in a state of syncope, or nearly approaching to it, unable to articulate, with a pulse scarcely perceptible, and the skin clammy and cold, an immediate operation would only hasten his death; but if excited by stimulants and cordials, he will have some chance of recovering himself in a short time, so as to undergo the operation with a better prospect of success, or he will in that period sink and die. If, on the contrary, he is brought to the surgeon, although much alarmed and reduced by the sudden shock and loss of blood, with strong sensations of pain, expressed by his cries for assistance, convulsive motions of the limb and body, and the powers of the sensorium not destroyed, the operation should be performed immediately; or, instead of becoming more calm and collected, he will gradually sink into the state of the first described, and be unable to bear the operation. On the other hand, the first mentioned, if he be excitable, will in time rather approach to the state of the latter, and from the pain, &c. he suffers, will call for the performance of the operation. This violent nervous commotion, however, is not common; it depends upon particular idiosyncrasies, and will never in the first be so excessive as in the last.

The operation being decided upon, it is, I confess, not like that at the shoulder-joint, to be done by every one of moderate ability. No surgeon ought to attempt it, unless he is conscious of possessing great coolness, a presence of mind equal to any emergency, and a correct knowledge of the parts to be divided.

The fear usually entertained by surgeons, is that of incontrollable hæmorrhage; and Mr. John Bell (whose works have done so much good in the surgery of arteries) has here done much mischief, in persuading many young men, that hæ-

morrhage from large arteries is not to be restrained by any pressure; which is, in my opinion, one of the principal errors of his work, and is indeed almost as great an error as any he has laboured so effectually to overturn.

He says, page 415 of his Principles of Surgery, "I will repeat with confidence what I have frequently affirmed, that it is one thing to suppress the pulse in the lower part of the limb, and another thing to stop the pulse in the great artery. I have tried in great operations, near the trunk of the body, to stop the blood by pressure; but though I could suppress the pulse of the femoral artery with my fore-finger, I could not command its blood with the whole strength of my body." And in a note he says, "The fact which I have here affirmed is of too much importance for me not to maintain it with more than common earnestness. I affirm then, that though the throbbing of an aneurism, or the pulse in the lower part of the limb, be quite suppressed, yet the circulation is not stopped; and I entreat the young surgeon never to trust to any such mark of the compression being effectual."

If he wish it to be understood, that the inguinal, or the subclavian artery, cannot be commanded by any pressure, so as to prevent hæmorrhage on their division, it is merely advancing an opinion, that hardly needs a comment; for almost all the medical officers of the British army have, on many occasions, seen both vessels so effectually compressed by moderate pressure, that not one drop of blood has escaped from the orifice of the artery, after it has been divided. I am therefore willing to believe that this cannot be his meaning, but that he supposes a certain degree of pressure may stop the pulsation of the artery without suppressing the circulation: an opinion equally dangerous, and erroneous, as the other; for it tends to keep the mind of the young surgeon in alarm, and thereby obstructs the free exercise of his judgment, during the whole course of many serious operations, when he often requires the greatest firmness to enable him to surmount the difficulties that present themselves. This alarm is most

unnecessarily raised, for I have no hesitation in declaring, and I am supported in the assertion by all the surgeons of extensive practice in the British army, that when the pulse is suppressed in a great artery, the flow of blood is completely restrained for every purpose in surgery. I will even say, that the flow of blood may be entirely suppressed, and yet the pressure upon the subclavian artery above the clavicle shall be so moderate, that the instrument will not leave a mark upon the skin discoverable after twenty-four hours. I do not assert this without solid foundation, for I have seen the inguinal and subclavian arteries compressed and divided very many times, and I have had the femoral and axillary arteries as often, between my fingers; but I never saw blood projected one inch from the orifice of these vessels without a pulsatory motion being evident; and I never saw blood flow in a stream from the orifice of any large artery. I have seen, when the sides of these vessels have not been pressed exactly together, so that the inner coats have not been in contact, that a little blood has oozed to the mouth of the artery, and that it has even dropped from it; but the moment this drop became a stream, the motion of the artery was sensible to the fingers, and the blood thrown out, came per saltum. I have never found any difficulty in holding the divided ends of the femoral, or axillary arteries, between my finger and thumb, whilst a ligature has been placed upon them; and I know that the blood is not propelled in these arteries, with a force that is not readily overcome by moderate pressure. In a healthy man the circulation does not go on in an artery, when the pulse of that artery has ceased in consequence of pressure. It is not, indeed, consistent that it should; for, if the circulation could go on so as to cause a dangerous hæmorrhage, without any motion of the artery being discoverable, the occurrence of it in the smaller arteries in a state of health would almost appear unnecessary. If it be said, that it is not circulation, but merely a little blood that passes between the sides of the vessel that are

not exactly in contact, I would reply, that if such a thing does take place, the quantity must be so small, as to be unworthy the attention of the surgeon; for, if it were in greater quantity, it would be attended by the usual sensation of pulsation.

I do not mean, in the slightest degree, to doubt the correctness of Mr. Bell's statements, of his inability to suppress the circulation in the cases of aneurism he has adduced; I mean to assert only, that the passage of the blood through a healthy artery can be effectually prevented by moderate pressure; that when the pulse has ceased in a large artery in consequence of this pressure, the circulation is suppressed for every purpose in surgery; and that the surgeon may therefore divest himself of all fear of hæmorrhage. It is, indeed, a fact so notorious in the medical department of the army, that I need not have noticed it thus particularly, if I did not think the great authority of Mr. Bell's opinion might prevail, when the practice of the Peninsular war shall be forgotten.

When these observations were published in the first edition, the doctrines of Mr. John Bell on this subject were taught in London by his brother, Mr. C. Bell, and others; they have since that period been abandoned, and I derive one satisfaction from having written this book, in knowing that the fact was first publicly declared and maintained by military surgeons, and that by establishing it beyond all dispute, or doubt, they have rendered an essential service to the science and art of surgery. For it was impossible that men could proceed to any serious operation, impressed with the idea of being unable to control the flow of blood, with the same calmness and clearness that they can when such impression is removed. The fear of hæmorrhage was the sole reason formerly for considering amputation at the shoulder-joint a dangerous operation. It is the principal objection with many, even at present, to amputation at the hip-joint.

It is my intention now to put this matter in its proper point of view; and to assert, that there is not an artery in the human body on which an operation can be performed (I ex-

cept the aorta, to avoid unnecessary discussion), through which the passage of blood cannot be most easily prevented. The degree of pressure required on the sides of the inguinal, subclavian, axillary, or carotid arteries is trifling, and all that is required is to take care that it be correctly made. If these arteries be laid bare, the simple closing of the fingers is almost sufficient to place the sides of them in contact. If the inguinal or axillary, or other artery be cut across, whilst the vessel has lateral support, as in amputation in muscular parts, the passage of blood through it is suppressed, by placing the point of the finger on the open mouth of the artery, and retaining it in that position without almost any pressure whatever. I proved this assertion in the York Hospital in 1817, before a great number of students, in two amputations, one at the shoulder-joint, the other at the great trochanter. In each operation, after the limb had been removed, I allowed the femoral and axillary arteries to eject their blood in full stream, and immediately put a stop to it with the point of my fore-finger, and without using any perceptible compression, as was seen from the ease with which it was accomplished. I repeated this to show that it was not an accidental circumstance. I performed both operations without a tourniquet, and compression was not made on the subclavian artery until after the head of the humerus had been separated from the glenoid cavity, and the artery was about to be divided. Less blood than usual was lost in both operations, and the patients were discharged the hospital, cured.

The difficulty supposed to arise from this cause, was to be surmounted in the amputation at the hip-joint, by putting a ligature on the artery below Poupart's ligament; and all who have written on the subject, or attempted this amputation, have directed this operation, often considered serious in its performance, although in reality extremely simple, as a preliminary step. Tourniquets were not invented for this operation, as for the shoulder, for little dependence was placed on compression; and they knew there were several other arteries

to be divided, that could not be commanded by any external means. This consideration, combined with the great shock to the nervous system, and the supposed impossibility of a person surviving the operation, induced most surgeons to abandon it as a hopeless piece of barbarity.

The surgeon, after making himself acquainted with every part, but more especially with the course of the great vessels, and the insertion and attachment of the muscles in and near the trochanters, must endeavour to free himself from this dread of hæmorrhage, which shackles his hands and his judgment. If he cannot do this, he had better not attempt the operation, as its success must depend, in a great measure, on the celerity and ability with which it is performed, and on the due securing of the vessels with little loss of blood; two points that may be accomplished by a surgeon thus prepared, without difficulty. The larger an artery the more easily it is secured, and the femoral artery the most readily of all. The smaller vessels only require the ends of the fingers to be placed upon them to stop the flow of blood; and this support, which hardly amounts to compression, is sufficient for vessels of considerable size, such as the branches of the glutæal, sciatic, and obturatrix arteries, which are divided in the course of the operation. The femoral artery in the groin can always be held with ease between the finger and thumb, or pulled out by a tenaculum, until a ligature be put around it. In fact, surgeons must entirely throw off this dread of arterial bleeding, which they have, until lately, been taught, or they can never become good operators.

I think this operation should be performed only by persons who have already attained a competent knowledge of the relative situation of parts, and some dexterity in operating; and not, as at the shoulder-joint, by the junior officers of the department. I shall mention, however, the most important points of anatomy to be attended to, which may much expedite, or delay, the operation.

Immediately under the skin and cellular membrane there

is a strong fascia surrounding the thigh, and attached with the tendinous expansion of the glutæus maximus to the linea aspera, which attachment gives some little inconvenience, if not separated from the bone. Under this fascia there are twenty muscles surrounding the hip-joint, the whole of which must of course be divided. 1. Tensor vaginæ femoris. 2. Sartorius. 3. Rectus cruris. 4. Iliacus internus. 5. Psoas magnus. 6. Pectinæus. 7. Gracilis. 8. Triceps, arising by three distinct heads, longus, brevis, magnus. 9. Semitendinosus. 10. Biceps long head. 11. Semimembranosus. 12. Quadratus femoris. 13. Obturator externus. 14. Obturator internus. 15 and 16. Gemini. 17. Pyriformis. 18. Glutæus minimus. 19. Glutæus medius. 20. Glutæus maximus. Many of these are simply divided in the first incisions, without difficulty, or interference with the ulterior steps of the operation. The muscles immediately attached or inserted about the joint do, however, cause inconvenience if overlooked, or not known; and these are Nos. 4, 5, 6, 12, 13, 14, 15, 16, 17, 18, 19, and 20. The knowledge of the insertions of these muscles will enable the surgeon to understand and obviate any difficulty that may arise in dislocating the head of the femur.

The vessels are in four sets: the femoral, obturatrix, sciatic, and glutæal arteries. The femoral artery has the anterior crural nerve on the outside, and its corresponding vein on the inside, and may be compressed with certainty where it passes over the brim of the pelvis.

The obturatrix artery, whatever may be its origin, always comes out through the thyroid foramen; is not compressible, but is not of great size.

The sciatic artery is given off by the internal iliac, passes out of the pelvis below the pyriformis muscle, and divides into a number of branches running downwards towards the thigh, and anastomosing largely with vessels coming from the fore part: it is also not compressible, and several branches will bleed during the operation; but they are easily stopped

by the points of the fingers, and often cease to bleed spontaneously.

The glutæal artery is given off before the sciatic in the pelvis, comes out above the pyriformis muscle, and principally supplies the outside of the haunch. One large branch descends between the glutæus maximus and medius towards the thigh, supplying these muscles, and a branch or two may bleed during the operation, but they are not of much importance.

There may also be some small branches of the external pudic artery divided, but they will not in general require to be tied.

The femoral vein is large, and will on some occasions require a single thread to be placed over it; but this must, if possible, be avoided, and is only admissible, when the bleeding cannot be suppressed, and fears are entertained of a longer continuance of it.

The head of the bone is retained in the acetabulum by a very strong capsular ligament, and by an internal ligament, called the ligamentum teres, which, until it is divided, effectually prevents its dislocation.

The anterior crural nerve on the fore part, and the great sciatic on the back part, alone require observation, and they should be cut short.

This operation being considered necessary, it must, like all others, be done with reference to the parts remaining uninjured; but there is, in general, more choice in this instance than in many other operations; for the patient will seldom survive an injury, or the operation be recommended, in which there is not an opportunity of selecting the parts to be retained, for the formation of the flaps.

It has been recommended to commence the operation by amputating the thigh first, in the usual manner, and then, by cutting through the muscles which surround, or are attached to the bone, to remove it from the acetabulum. This I consider as two operations instead of one, by which much time is

lost, and nothing gained. The vessels are not so readily secured, and the parts will not be in such just apposition, or so favourably disposed to unite.

It was proposed formerly in France, by Messrs. Volher and Puthod, to commence the operation by tying the artery on the fore part of the thigh; when the patient is to be placed on the opposite side, resting upon the ileum and the great trochanter. An incision is then to be made from about three fingers breadth below the tuberosity of the ischium, through the integuments forwards, so as to expose the tendon of the glutæus maximus inserted into the linea aspera, which is to be cut through to form the flap on the under part with the semimembranosus, semitendinosus, and biceps; the glutæus medius and minimus are to be cut through, with the muscles inserted between the trochanters. The capsular ligament is then opened into, the ligamentum teres divided, and the head of the bone dislocated. The muscles and integuments on the inside remain to be cut through, when the operation is completed. It was allowed by its advocates to be a tedious, and it must be a very inconvenient, operation; for the knife, in detaching the different muscles from their attachments, may cut much more than is intended, as its effects are not observable. The hæmorrhage is from a hollow space, and not so readily commanded; and every step of the operation, after the first incision, is difficult and tedious.

The Baron Larrey describes his method of performing the operation as follows*: "I place the patient nearly in a horizontal position on the foot of the bed, and stand on the inside of the thigh to be operated upon, an able and intelligent assistant compressing the artery where it passes over the brim of the pelvis. I make an incision in the groin in the course of the great vessels, which I carefully lay bare; and having separated the anterior crural nerve, which is on the outside of the artery and vein, I pass a blunt curved needle under them,

* See tome ii, p. 186.

so as to include both together in the same ligature. I take care to make this ligature immediately below the crural arch, so as to tie the vessel above the origin of the profunda, the division of which, during the operation, without this precaution, might cause a fatal hæmorrhage. Having tied the femoral artery, and placed a ligature above it, to be tightened, if necessary (ligature d'attente), I plunge my straight, sharp-pointed knife perpendicularly into the thigh, between the tendons that are attached to the little trochanter, and the base of the neck of the femur, bringing out the point of the instrument diametrically opposite, on the posterior part of the thigh or buttock, and by then directing it obliquely downwards and inwards, it cuts itself out through all the parts which ought to form the inner flap, which should not be too large. This flap is to be raised up towards the scrotum by an assistant, and the articulation is immediately visible. The obturatrix and some branches of the external pudic artery are divided, and these must be immediately secured. A single stroke of the bistoury is sufficient to divide the capsular ligament; the head of the femur is almost dislocated by simply moving the bone outwards, and it will readily be conceived how easily the ligamentum teres may be divided by the same instrument. I then form the outer flap by passing the cutting edge of a small straight knife between the brim of the acetabulum and the great trochanter, carrying it downwards and outwards, nearly on a level with this tuberosity, so as to give a rounded form to the flap. The assistant who holds the flap stops the mouths of the bleeding vessels with his fingers, until they can be tied, and the smallest arteries should be secured to prevent secondary hæmorrhage, and to allow of the union of the flaps. If these flaps are not diseased, nor inflamed, nor irritable, or, in other words, are healthy, some stitches by the interrupted suture may be made in the integuments to keep the parts together, but the muscles must not be included. The flaps are to be kept in contact by compresses moistened in red wine, and by a retaining bandage.

"I have always found it a quick and easy operation, and had planned the mode of doing it before I entered into the service; and the trials I made on animals, and on the dead body, led me to hope for a successful result on the living.

"The surgeon must afterwards attend to the general state of the patient. Bleeding, if there be any indication of plethora, with refrigerants, antispasmodics, perfect quiet, and proper diet are not to be neglected. By these means the inflammatory symptoms usually accompanying great operations, such as amputation, are obviated. The adhesion of the flaps quickly takes place, and suppuration is established only where some bruised or injured parts have remained in the wound."

This last remark of M. Larrey I consider a very valuable one, as it is a complete answer to all his own objections to union by the first intention after primary amputation in other parts, and especially at the shoulder and thigh; for every evil and every accident that can happen in these or other places, in consequence of the attempt to procure union, will, I conceive, occur in the hip; and if it be an object to avoid them in every other part, it must be equally so there; for, if union is not desirable after amputation at the shoulder or thigh, I do not see why it should be sought for at the hip alone.

To the method of operating I have some objections. I consider the preliminary step of tying the artery and vein as unnecessary, and only prolonging the operation; the placing of a precautionary ligature above, to be drawn tight if necessary (ligature d'attente), is now universally allowed in England to be extremely dangerous, inducing rather hæmorrhage by causing ulceration of the coats of the artery, against which it presses, than preventing it, being therefore itself the cause of the mischief it is intended to suppress. The artery should be tied separately, and the vein should not be included in a ligature if it can be avoided. To make the internal flap in the manner recommended by M. Larrey, a knife for the express purpose will be required, as it must be long, narrow,

straight, pointed, and have two cutting edges. The flap made in this manner will, without care, contain too much muscle for the integuments; and as the knife is only used for this step of the operation, its place may be supplied by the common one, cutting from without, inwards. I also consider the outer flap is better made, by cutting in the same manner, through the integuments from without.

The operation will be best performed in the following manner: The patient should be laid on a low table, or two field panniers placed together, covered with a folded blanket to prevent the edges giving pain, and properly supported in a horizontal position. An assistant, standing on the opposite side, and leaning over, should compress the artery against the brim of the pelvis, with a firm, hard compress of linen; such as is generally used before the tourniquet; he should also be able to do it with his thumb, behind the compress, if it be found insufficient. The surgeon standing on the inside, with a strong, pointed amputating knife of a middle size, makes his first incision through the skin, cellular membrane, and fascia, so as to mark out the flaps on each side, commencing about four fingers' breadth, and in a direct line below the anterior superior spinous process of the ileum in a well-sized man; and continuing it round in a slanting direction at an almost equal distance from the tuberosity of the ischium, nearly opposite to the place where the incision commenced. Bringing the knife to the outside of the thigh, he connects the point of the incision where he left off with the place of commencement, by a gently curved line, by which means the outer incision is not in extent more than one-third of the size of the internal one. The integuments having retracted, the glutæus maximus is to be cut from its insertion in the linea aspera, and the tendons of the glutæus medius and minimus from the top of the trochanter major. The surgeon now placing the edge of the knife on the line of the retracted muscles of the first incision, cuts steadily through the whole of the others, blood-vessels, &c. on the inside of the thigh. The artery and vein, or two

arteries and a vein, if the profunda is given off high up, are to be taken between the fingers and thumb of the left hand, until the surgeon can draw each vessel out with the tenaculum, and place a ligature upon it. Whilst this is doing, the assistants should press with their fingers on any small vessels that bleed. The surgeon then cuts through the small muscles running to be inserted between the trochanters, and those on the under part of the thigh, not yet divided; and with a large scalpel opens into the capsular ligament, the bone being strongly moved outwards, by which its round head puts the ligament on the stretch. Having extensively divided it on the fore part and inside, the ligamentum teres may now be readily cut through. The head of the bone is then easily dislocated, and two or three strokes of the knife separate any attachment the thigh may still have to the pelvis. The vessels are now carefully to be secured. The capsular ligament, and as much of the ligamentous edge of the acetabulum ought to be removed as can readily be taken away. The nerves, if long, are to be cut short, the wound well sponged with cold water, and the integuments brought together in a line from the spinous process of the ileum to the tuberosity of the ischium. Three sutures will in general be required, in addition to the straps of adhesive plaister, to keep the parts together; the ligatures are to be brought out in a direct line between the sutures, a little lint and some compresses are to be placed over the wound, and on the under flap, to keep it in contact with the cotyloid cavity, and assist the union of the parts. A piece of fine linen is to be laid over them, and the whole retained by a calico bandage put round the waist, and brought over the wound.

It is recommended to pare the cartilage from the bone; and if this could be readily done, I would agree to it, but the cartilaginous surface of the acetabulum is not to be cut away without much difficulty and some time, which cannot be spared; for I consider the success of the operation to depend very much upon the quickness with which it is performed, not

on account of hæmorrhage, but to avoid the shock the constitution receives from the continued exposure and irritation of so large a surface in the immediate vicinity of the trunk of the body. It is proved by experience to be unnecessary at the shoulder-joint; and will, I think, be found equally so at the hip.

Union by the first intention is to be wished for in a great degree, as lessening the surface of the wound; but as all the parts beneath the skin cannot unite, and especially about the acetabulum and the inside of the glutæus muscle, it is not advisable to let the skin adhere on the middle and lower part of the stump; for, as the parts deep-seated must suppurate and granulate, a fair opening for the discharge should be preserved, and collections of matter in any part should be carefully guarded against by gentle pressure, compress, and bandage.

In my successful case, the particulars of which have been already related, the situation of the posterior shot-hole prevented, in a great measure, the inconvenience likely to arise from any retention of matter; it became necessary, however, to make an opening at this part during the cure; and, from a due consideration of all these circumstances, I now recommend that an opening should be made through the outer flap at the period of operating, immediately below the acetabulum, into which a piece of lint should be introduced until suppuration is duly established, when it may be readily kept open until all fear of the collection of matter has subsided or been removed. If it should collect, although every precaution be taken to prevent it, an opening should be made at a dependent part with as little delay as possible.

The after-treatment will be the same as in the other cases of amputation: the shock, however, of the injury and the amputation will be so great, that the antiphlogistic regimen, to the extent of blood-letting, will seldom be necessary. If the patient be very low, cordials in small quantities, with opiates, should be given, and a light nourishing diet. If inflammatory symptoms come on, the appropriate remedies for-

merly recommended must be employed without delay. If there be heat or uneasiness in the wound, it must be kept wet with cold water.

If the surgeons called upon to perform this operation have not been in the habit of dealing with large arteries, they may feel an unconquerable repugnance to cutting through the femoral artery before it has been tied; and although I can most positively assure these gentlemen, there is nothing to fear in doing it, still they may tie the artery first, if they cannot overcome this feeling of danger. It is to be done by cutting through the integuments in the usual manner, and then dissecting for the artery and vein, previously to cutting through the muscles.

The cases and facts I have related establish amputation at the hip-joint as a successful operation. The danger arising from loss of blood is proved to be trifling, and no bad consequence has ever resulted from it. The operation itself cannot be difficult, because so many persons have been able to accomplish it. The shock to the constitution or system at large, although undeniably great, has been proved not to be beyond its powers of supporting. If we refer to the number of persons on whom it has been done, it will be found to amount to about twenty: of these, three perfectly recovered, and three are now living; seven lived long enough to get the better of the first effects of the operation, and to show that they would in all probability have been cured, if death had not been caused by disease totally independent of the operation; the remaining ten died, but all of them lived some hours, and several many days, after its performance, although in most of these cases the chance of success was at first but small. I do not apprehend that the same success has attended the operation of placing a ligature on the subclavian artery; yet there is not a surgeon, with any pretensions to professional character, who would decline doing this operation in a proper case requiring it. This being the fact, I should be glad to be informed on what principle amputation at the hip-joint can

be now objected to, unless it be on the incapability of the surgeon to do it. I know of no other that can be advanced, after the most attentive consideration of the subject; for conceding even that all the persons died on whom it was done except three, which is a concession no reasonable man would demand on reading the particulars of each case, the operation is still a saviour of three; and when this chance of one in seven is left, it ought to be offered to the patient, and he alone should decide. Let it however be recollected, that Mr. Brownrigg saved one out of three; that I saved one of two; Mr. Orton succeeded in the first case; that many operations were done as a last resource at the entreaty of the patients, who were eager to avail themselves of the slightest hope; and no unprejudiced person, from a careful survey of the facts, can consider the chances for success as less than one in three or four. I can, for my part, only express my conviction, that it is an important addition to the means which surgery possesses of giving relief to suffering humanity; and, so far from being a barbarous or rash experiment, surgeons will hereafter be charged with either a want of humanity, or of dexterity, who refuse to perform it when the case admits of no other relief, the patient is desirous of submitting to it, and there is a reasonable chance of success.

In these observations I have referred only to injuries of the part as a cause demanding the operation; it is possible that it may be required, on account of disease affecting the thigh, without any immediate external injury. The principal one would appear to be, the complaint known as the scrofulous affection of the hip-joint; but it never can be successful in such cases, because the acetabulum is always implicated in the disease, as was the case in the children operated on by Dr. Kerr and M. Baffos.

The propriety of the operation in certain cases of diseased thigh-bone, is less doubtful; and, as far as I can judge, deserves serious consideration, not only by careful inquiry, but by experiment. I allude especially to the different kinds

of exostosis described by Sir A. Cooper, in his Surgical Essays, Part I, and other tumours of an anomalous nature, which are evidently incurable, and which would be certainly destructive to life. These cases, when they have occurred at the upper part of the thigh, have been generally left to take their own course and to kill the patient, principally because amputation at the hip-joint was considered too serious an operation. This objection is, I hope, for ever removed; but another remains of considerable importance, the possibility of disease occurring in other parts of the body, or even in the part itself, if the whole of the bone be not removed. Upon this point I beg leave to refer to Sir A. Cooper's book for particular information; giving it, however, as my own opinion, that in all such cases, where the constitution of the patient seems to be but little impaired, and the disease incurable, proceeding with more or less rapid steps to destruction, the operation should be performed, and the patient allowed this one chance of life. That the disease, or another like it, may appear in some other part of the body, is doubtful; that it will soon destroy where it is, and with horrible torment, is certain. It is this point, then, which requires consideration, supported by the result of several trials made in each particular kind of case. If they prove invariably fatal in every different kind of disease, an operation is useless: if, on the contary, it be found, that in certain cases amputation is successful, greater attention must be paid to discriminate the cases.

In February, 1817, a gentleman in Welbeck Street sent for me, to know whether I would amputate his thigh at the hip-joint, having understood that I had successfully performed that operation. On desiring to know his reason for such a request, he showed a tumour on the middle of the thigh of considerable magnitude, which was pronounced incurable by the most eminent surgeons, and from which he was suffering the most horrible torments. On examination, I assured him there would be no difficulty in removing his thigh at the joint, if the operation were considered advisable, or even by sawing

through the trochanter major. This latter operation was decided upon in consultation with Sir A. Cooper, who insisted, with great liberality, that as the gentleman had sent for me for the purpose, I should do it. He was also so kind as to be present at it, and to compress the artery against the bone at the groin. The limb was removed by the circular incision, nearly however in the manner I have described as in amputation at the hip-joint; the bone was sawed through at the trochanter major, and the arteries tied afterwards, a ligature being placed separately on the femoral artery and on the profunda. He lost very little blood, certainly not a pint, and was taken out and returned to bed in fifteen minutes. The line of incision was formed horizontally, and towards the anterior part of the groin. In this case matter formed in the stump in four different places, and required four incisions of from two to three inches and a half extent, to give free vent to the discharge. At the end of six weeks the stump cicatrized, and he was able to walk about the town on crutches. Being caught in the rain, in Bond Street, in one of these excursions, he suffered an attack of spasm and inflammation on the chest, for which he did not apply for advice for several days, and then too late; symptoms of effusion came on, and terminated his existence. His widow would not allow the body to be opened, and the state of the disease in the chest could not be ascertained. Dr. Baillie, who saw him, thought it unconnected with the former disease in the thigh; Sir A. Cooper thinks that tubercles formed on the lungs, and the wetting he experienced, brought them into action, by casually inducing inflammation.

Of Amputation of the Thigh.

The important difference of success in primary and secondary amputations, arising from many causes which it would be unnecessary to repeat, renders a due consideration of severe wounds of the thigh essentially necessary; and the know-

ledge, skill, and just discrimination of a surgeon, are perhaps no where more tried, than in deciding upon cases of severe wounds of the thigh as requiring amputation or not; for delay improperly advised is almost tantamount to a sentence of death, whilst immediate amputation may be considered as the harbinger of safety.

Wounds from cannon-shot, or shells, in general show their nature sufficiently to enable the surgeon to decide without much chance of error. There are cases, however, in which it becomes more difficult, as in the case related page 330, which although successful under particular circumstances, would have been otherwise in a different situation. In cases then of extensive wounds of the integuments and muscular part of the thigh by cannon-shot, where the great vessels, the bone, or the great nerves are not injured, the limb should not be amputated, as with care it may be saved; but if this care cannot be given, and the operation is required as high as the middle of the thigh, the patient will have a better chance of recovery, if it be done immediately.

If a cannon-shot strike the back part of the thigh, and carry away the muscular part behind, and with it the great sciatic nerve, amputation is necessary, even if the bone be untouched; for, although the wound might in some measure heal, the motion of the leg would be lost, and it would become an insupportable burthen to the patient. In this case, I would not perform the operation by the circular incision, but would preserve a flap from the fore part, or sides, as I could get it, to cover the bone, which should be short; I would then cut away the injured part, leaving a clear incised surface, enforcing at the same time the most severe antiphlogistic regimen, and reducing the local inflammatory symptoms as they appeared, by the application of cold or iced water, and leeches. The object to be gained by this kind of operation is to obtain a longer stump than could be made by the circular incision; which is more readily explained as follows:—A cannon-shot strikes the outer

part of the thigh below its middle, and fractures the bone, with much laceration of the muscles of the outside, the muscles and integuments on the inside remaining sound; allowing the bone to be but little splintered, amputation by the circular incision will require its removal at the lesser trochanter, on account of the want of soft parts; whereas, if the covering for the bone be saved principally or entirely from the inside, the amputation may be safely done much lower down, and the surgeon has the advantage, by this operation, of examining the bone as he proceeds, and making his flaps accordingly; but if the injury committed on the soft parts does not render this possible, or enable the surgeon to save a longer stump, the circular incision is to be preferred.

A cannon-shot in full force, breaking the bone in any way with a wound of the integuments, will always require amputation; and if the integuments be not divided, in consequence of the diminished velocity of the ball, it will yet in general be necessary, from the comminuted nature of the fracture, and the total disorganization of the soft parts; but these cases are of rare occurrence.

A cannon-shot destroying the artery and vein on the inside, without injuring the bone, requires amputation. A one or two pound shot may pass through without much evident mischief; and as the artery, when fairly divided, does not necessarily bleed for any length of time, the injury may not appear very extensive, when the man reaches the surgeon: but amputation is not less necessary, for the patient would otherwise not only lose his leg, but probably his life, in consequence of mortification taking place.

In a wound of this kind, from a musket-ball, or small cannister-shot, dividing the artery or vein, or passing between them without opening into either, a different practice is to be adopted. The injury will sometimes not be discovered, until pointed out by the gangrene of the toes and feet. The hæmorrhage will often, under different circumstances, suffi-

ciently indicate the mischief; and if it continue, the vessels are to be cut down upon and examined; if the artery alone is wounded, both its ends should be secured in sound parts, and the result carefully awaited; but if the artery and vein are both injured, amputation will, I think, be necessary. It is most certainly a very severe measure for a wound, apparently of little moment, which, even in some cases, after a few minutes, shall not bleed; and yet I do believe, that when the femoral artery and vein are both wounded, it must ultimately be performed, or the patient will die of grangrene of the extremity. Few persons will, indeed, submit to so formidable an operation, or can be made sensible of their danger, from so apparently slight a wound, until they see the danger approaching with rapid strides, in the shape of mortification, on the third or fourth day; and this should always be kept in view in such cases, that the operation may be done as soon as possible, after the preservation of the limb is obviously impracticable. In every case I have seen in which the femoral artery and vein were both wounded, gangrene of the limb was the consequence.

An injury of the artery requiring an operation, accompanied by fracture of the bone of the most simple kind, is a proper case for immediate amputation; for although many patients would recover from either accident alone, none would, I believe, surmount the two united; and the higher the accident is in the thigh, the more imperious is the necessity for amputation.

If, after a fracture by gun-shot, that is successfully treating as far as regards the consolidation of the bone, which is always more or less irregular, any accident or motion of the limb should cause a rough part of the bone to wound the artery or vein (and I have seen a case of this kind, causing hæmorrhage), amputation is advisable, as being the best calculated to save the patient's life. The operation for aneurism higher in the thigh will inevitably fail, and cutting down upon the vessel to tie both its extremities, would cause so much ac-

tion in a part not in a perfectly healthy state, that the consequences would be fatal; and if amputation be subsequently resorted to with the view of obviating them, it will be done under very unfavourable circumstances.

Injuries of the femur from musket-balls are the more common wounds that render amputation necessary, and the treatment of the most favourable cases requires the greatest attention and considerable surgical knowledge. It is here my intention to point out only such cases as require amputation on the field of battle; for, in secondary cases, the operation is indicated in general by the health of the patient, unless accidental circumstances occur in the wound that render it necessary. Having had a very extensive practice in wounds of this kind, I feel obliged to agree in the opinion of M. Larrey, expressed in his Inquiry into the Practice of Faure, in the 2d vol. of his Campagnes, page 503. The case was a simple fracture of the body of the femur by a musket-ball, without particular injury to the soft parts, on account of which amputation was performed the forty-second day. He says, "I do not disapprove of this operation, for my experience has taught me, that all wounds with fracture of the thigh are very dangerous, and almost all require amputation, which cannot always be done in the first instance; and it is one of those cases in which it may be deferred to the secondary period of operation."

Fracture of the femur from musket-balls is, then, a very common cause of amputation; and this may appear singular, when contrasted with the ease with which simple fractures are cured in domestic surgery; and even with the success attendant on compound ones in other parts. This difference arises principally from the manner in which the bone is broken. In accidents in civil life, it is in general merely broken across, or obliquely, with the point thrust through the soft parts. In gun-shot wounds, it is generally the reverse, being much shattered, and not appearing through the integuments;

depending very much on the part of the bone injured, and the manner in which it has been struck by the ball.

If a musket-ball, in passing through the thigh, merely touch the bone, it may fracture it directly across, but it will generally do it obliquely, so as to cause some little shortening of the limb when cured under the most attentive treatment; but when a ball strikes the shaft or body of the femur, it shatters the bone in every direction, although it may not pass through: it does not merely break off four or five small pieces, which may be taken away by cutting down upon the bone, but it breaks it into large pieces, generally oblique and very pointed, that retain their attachment to the muscles inserted into them. The fractures extend far above and below the immediate part struck by the ball; and, as far as depends upon my information from the examination of limbs that were amputated, further downwards than upwards; so that from a fracture in the middle of the thigh, I have often seen fissures extend into the condyles, and cause ulceration of the cartilages of the knee-joint; but they seldom extend upwards as high as the trochanters. Of such cases, there can be no doubt as to the propriety of immediate amputation; but if the fracture did not communicate with the joint, when the middle of the body of the bone is broken into several large pieces, it is better to amputate before the inflammatory symptoms come on, than afterwards; for it must then be done higher up, or probably cannot be done at all.

The danger and difficulty of cure attendant on fractures of the femur from gun-shot wounds, depend much on the part of the bone injured; and, in the consideration of these circumstances, it will be useful to divide it into five parts. Of these, the head and neck included in the capsular ligament may be considered the first, the body of the bone, which may be divided into three parts, and the spongy portion of the lower end of the bone exterior to the capsular ligament, forming the fifth part. Of these, the fractures of the first kind are, I believe, always ultimately fatal, although life may be prolonged

for some time. The upper third of the body of the bone, if badly fractured, generally causes death at the end of six or eight weeks of acute suffering. I have seen few escape, and then not with a useful limb, that had been badly fractured in the middle part. Fractures of the lower or fifth division are in the next degree dangerous, as they generally affect the joint; and the least dangerous are fractures of the lower third of the body of the bone. Of these even I do not mean to conceal, that when there is much shattered bone, the danger is great; so that a fractured thigh by gun-shot, even without particular injury of the soft parts, is one of the most dangerous kind of wounds that can occur.

Upon a review of the many cases I have seen, I do not believe that more than one-sixth recovered so as to have useful limbs; two-thirds of the whole died, either with or without amputation; and the limbs of the remaining sixth were not only nearly useless, but a cause of much uneasiness to them for the remainder of their lives; they were indeed much in the same state as Bilguer's invalids, who were incapable of any employment, civil or military.

It would be an interesting, and I am sure a useful inquiry to examine the lists, or cause lists to be made of British soldiers, who receive pensions on account of incapability for service, from wounds with fracture of the thigh-bone; and I am satisfied the number would be small, although the accident is not infrequent; and of the number thus receiving pensions, I will venture to predict, it will be found that in seven-eighths the bone was broken below the middle of the thigh.

After the battle of Toulouse, forty-three of the best of the fractures of the thigh were attempted to be saved; having been carried from the field of battle but a very short distance, well accommodated in hospital, and attended for the most part with great care and surgical attention: of this number, thirteen died; twelve were amputated secondarily, of whom seven died; and eighteen retained their limbs. Of these eighteen cases, the state, three months after the battle, was as

follows: "Five only can be considered well, or as using their limbs. Two more think their limbs more valuable (although not very serviceable) than a wooden leg: and the remaining eleven wish they had suffered amputation at first, as they are not likely to do well: and if they eventually recover, which in many is doubtful, the limb will be distorted and unserviceable." Of two officers with fracture of the femur, one died in the hands of the French surgeons, in whose charge he fell during the action, and by whom he was skilfully treated; the other, with the greatest possible attention and care, has preserved a limb, which I think he now wishes exchanged for a cork leg.

In the five successful cases, the injury was, in all, at or below the middle of the thigh. In the thirteen others, who retained their limbs, the injury was not above the middle third; and of those who died unamputated several were near, or in the upper third, and either died before the proper period for amputation, or were not ultimately in a state to undergo the operation. Of the seven amputations that died, two were at the little trochanter by the flap operation, and the others, for the most part, unfavourable cases. In one case only was the head or neck of the bone fractured by a musket-ball, which had entered on the outer and back part, and afterwards went through the scrotum and penis. This man was not pointed out to me for some days, and was not at that time, or ever afterwards, in a state to render amputation likely to be successful. He lived however for two months; and, from the dreadful sufferings he endured, I always regretted amputation at the hip-joint had not been performed at first.

After other battles, in which I have had the care of fractures of the femur, the success has not been so great, but they were generally under less advantageous circumstances; and from the sum of knowledge thus acquired on many occasions, I am induced to believe, that in this injury, amputation ought to be a more frequent operation than it is at present; and I think I am borne out in this supposition by the above state-

ments, and by the general opinion of my brethren formed during the Peninsular war.

I think it will also be conceded by those who are disposed to allow the advantage and safety of primary operations, that if the thirty-six of the forty-three who died, and have only partially recovered, had been amputated on the first day, the country would have had at least twenty-five stout men, able, for the most part, to support themselves by their labour, instead of five, or, at most, ten, who will not be entirely dependent upon their pensions and parishes for their subsistence.

As secondary amputation is totally inadequate to produce this effect, the patient should be carefully examined, and amputation performed, when necessary, on the field of battle. If the heat of the weather be great, as in the summer of the Peninsula, Asia, or America, the hospital to which the patient must be removed at some distance, the means of conveyance bad, or the wounded very numerous, it is better to amputate, even in a doubtful case; and if the surgeon, by following this rule, should even cut off a limb that might have been saved, he will be amply compensated by the preservation of a number of lives, that would be lost by delay under precisely similar circumstances.

In regard to officers, some little more latitude is to be granted than the above suggestions allow; for, as they can often procure cool apartments in summer, good conveyance, plentiful attendance, and the best professional advice, all of which are occasionally wanting to soldiers, cases of disease and injury will always succeed in a greater proportion with them than with private soldiers in hospital; but not in so great a degree as to counteract my opinions in cases that are really serious.

It is a difficult thing to persuade a surgeon unaccustomed to the treatment of gun-shot wounds, or the patient himself, when he sees but a small wound, that amputation is necessary; and as cases of success have been heard of by all, whilst the fatal ones are buried in oblivion, many officers will not choose

to submit to it, and will rather hazard their future health and happiness, and undergo the most dreadful sufferings, for months, to save a limb, which when cured, and their wishes are obtained as far as circumstances will permit, they find a useless burthen, and a source of inconvenience for the rest of their lives.

Wounds from musket-balls, injuring the lower part of the bone, without communicating with the joint, do not require primary amputation; they are proper cases for delay, unless there be great destruction of parts.

It must, however, be borne in mind, that all compound fractures of the thigh should be placed in the straight position, and, if possible, from the moment of injury. I am aware, in giving this opinion, that I am differing from some of my brethren in the army, as well as in civil life; and I only do it, because I consider it imperiously necessary from motives of humanity to do so; and that as my opportunities for observation have been greater than many others have possessed, I am more called upon to give an opinion. It has also been a subject to which I have paid particular attention; and the result of several trials was so decidedly in favour of the extended position, that after the battle of Toulouse I gave a positive order, that no limb should be placed in any other position, without a reason being specially given for it. The greater success which attended the treatment of fractures of the thigh after this battle than any other, was owing to this kind of treatment, which met the approbation of, and was most zealously enforced by, the different heads of hospitals. After the battle of Waterloo this was not so particularly attended to; but when I pointed out to the different gentlemen in charge, the greater advantages of it, they who had not already done so immediately adopted it. In several cases the inconvenience of not having done it from the first was discovered, even as soon as a fortnight afterwards, union or adhesion having taken place to a sufficient extent to prevent the necessary change of position being accomplished.

Wounds of the knee-joint, with fracture of the great bones composing it from musket-balls, require amputation, for I do not consider excision of the knee-joint likely to succeed in military practice; or, if it succeed in an individual case, ever to become general, from the great care, quietude, and attention it requires, independently of the danger to which it exposes the patient. It is almost unnecessary to state, that the relief for wounds of this kind is to be obtained by amputating the limb; and, from an extensive practice in wounds of the knee-joint, with fracture of the articulating surface of the femur or tibia, I have no hesitation in declaring amputation to be imperiously demanded, and that it ought to be performed with the least possible delay consistent with propriety; and on no account should the surgeon wait to give the wound a trial; for I most solemnly protest, I do not remember a case recover in which I knew the articulating end of the femur or tibia to be fractured by a ball that passed through the joint, although I have tried great numbers, even to the last battle of Toulouse. I know that persons wounded in this way have lived, for a recovery it cannot be called, where the limb is useless, bent backward, and a constant source of irritation and distress, after several months of acute suffering, to obtain even this partial security from impending death; but if one case of recovery should take place in fifty, is it any sort of equivalent for the sacrifice of the other forty-nine? or, is the preserving of a limb of this kind an equivalent for the loss of one man? The answer is, I believe, clear, and the practice ought to be as decisive; for secondary amputation offers not half the chance of success, and many will not outlive the inflammatory symptoms and fever that ensue. I am aware that this point has been much argued, but the practice of the Peninsular war has been so great and so decisive, that the opinion of all the surgeons of the British army of experience, is for immediate amputation in cases of this kind.

Fractures of the patella, without injury of the other bones, admit of delay, provided the bone is not much splintered.

If the ball has pierced the centre of the patella, and passed out nearly in an opposite direction behind, the limb will not be saved; or if the ball has struck the patella on its edge, and gone through it transversely, opening into the joint, it will very rarely or never be saved; but if it be merely fractured, there is hope under the most rigorous antiphlogistic treatment, and delay is proper.

A ball will occasionally penetrate the capsular ligament, and lodge in the knee-joint, without fracturing the bone; if it cannot be extracted without opening extensively into the cavity of the joint, and the extraction of the ball be absolutely necessary, amputation had better be performed at first, for it will be ultimately advisable.

The condyles of the femur and the lower part of the bone being spongy, a ball may pass through them, or between them, and fall into the knee-joint; or it may make a prominence on the side of the patella, without passing out, or immediately interrupting the motion of the leg, for the soldier may walk some distance afterwards; the popliteal artery may also be divided in addition, and either of these cases will render amputation necessary; for the ball must be taken out on the fore part, and the general inflammation of the joint will either destroy the patient in a short time, or, after much distress and hazard, leave him no alternative but amputation.

If a ball lodge in the condyles of the femur, within the capsular ligament, and cannot be easily extracted, amputation is advisable; for the limb, if preserved, will not be a useful one. If the ball, on the other hand, lodge without the capsular ligament, and cannot readily be extracted, the wound should be healed as soon as possible; and although it may cause some little inconvenience to the knee-joint, it will preserve the limb and life of the patient; as I have seen in many instances, when a continuance of persevering efforts to extract it, would have exposed both to great hazard.

Many cases of wounds of the knee-joint, in which the capsular ligament is wounded, and the articulation opened into

without injury to the bones, do well, such as simple incised wounds, made with a clean cutting instrument, suddenly withdrawn after inflicting the wound: but several are also ultimately amputated, or the patient recovers with a limited use of a contracted knee. Some few indeed anchylose straight, but this number is very small. All these cases admit of delay, except when the capsular ligament is *extensively* opened into, when immediate amputation is to be performed. The success attending wounds of the knee-joint depends entirely upon the antiphlogistic mode of treatment being rigidly enforced, and to a very great extent. The limb is to be placed in the straight position, a splint is to be put underneath it in order to prevent any motion, and cold, in the shape of iced water, is to be applied, especially in summer, to diminish the increasing heat. General bleeding should be had recourse to in sufficient quantity to keep all general inflammatory action in due bounds; but it is on local blood-letting the surgeon must principally rely for the *prevention* of inflammation. Cupping can sometimes be performed with very marked effect; but leeches are more serviceable when they can be procured in sufficient numbers. From forty to eighty should be applied at a time; and whenever the sensation of heat is felt, and accompanied by pain, they should be repeated *until* these symptoms subside. The necessity for the local abstraction of blood is so great, that it should never be lost sight of for a moment; for, if suppuration take place throughout the cavity of the joint, it is followed in most instances by ulceration of the cartilages and caries of the bones. It is for this reason that a fracture of either of the articulating ends of the bones of the knee-joint is so very dangerous, as suppuration, to a considerable extent, can seldom be prevented, on account of the fracture, which is in the state of a compound fracture with an external communication, under which circumstances suppuration must take place to effect a cure. By local and general bleeding, the application of cold, rigid abstinence, and the straight position, a recovery may sometimes be ef-

fected; but wounds of the knee-joint, however simple, should always be considered of a very dangerous nature, infinitely more so than of the shoulder, the elbow, or the ankle. When a poultice is applied to a gun-shot wound of this kind, I consider it the precursor of amputation.

I could relate an infinite number of cases on these points, terminating fatally, or in amputation, where the injury was severe, or apparently at first but slight; and but few cases where the capsular ligament has been opened into by a musket-ball, where the patient has preserved the use of the limb. In every case, where the wound was known to be serious, I have invariably been disappointed in the hope of saving the limb.

The following case, as an instance of apparent simple injury that frequently occurs, will show the danger of all these wounds, and the very great care and attention that is necessary for their cure.

Colonel Donnellan, of the 48th regiment, was wounded at the battle of Talavera, in the knee-joint, by a musket-ball, which gave him so little uneasiness, that when a roller had been put on his leg with some simple dressing, he could scarcely be persuaded to proceed to the rear. At a little distance from the fire of the enemy, we talked over the affairs of the moment, when, tossing his leg about on his saddle, he declared he felt no inconvenience from the wound, and would go back, as he saw his corps was very much exposed. I explained to him the dangerous nature of wounds of the knee-joint, and after he had stayed with me a couple of hours, I persuaded him to go into the town. This injury, although at first to all appearance so trifling, and under the best surgical care, caused the death of this officer in a very short time, and proceeded so rapidly, as to prevent any relief at last being obtained from amputation.

When amputation of the thigh is necessary, it may be done in two ways, by the flap operation, and by the common circular incision.

The flap operation ought only to be done at the upper part of the thigh, is very similar to that proposed for the hip-joint, and is, in some instances, preferable to the circular incision, as it permits a longer stump to be saved, where the integuments are not sound in a circular direction. The difference between this operation, and that at the hip, consists in its being done lower down on the fore part of the thigh, and in the flaps being preserved more immediately from the out and inside of the thigh, the inner flap being the largest, to prevent the inconvenience that will result from the external one being tightly stretched over the end of the bone; and from this same cause it is advisable, that the bone be in general sawed off near to the lesser trochanter, even when the nature of the injury would allow of its being left an inch longer; for this inch would only add to the danger of protrusion, without being of any utility to the patient; and it is of vital importance, that all the parts after an operation of this kind should be free from pressure and irritation.

For the flap operation the patient should be placed in a position nearly horizontal, on a low table, and properly supported. A flannel or calico roller is then to be fastened round the waist, and the inguinal artery compressed against the os pubis. The surgeon standing on the inside of the left thigh, and the outside of the right, commences his incision through the integuments on the anterior part of the thigh, and carries it down with a gentle curve to the inner and upper part: he then makes the outer incision in the opposite direction, and brings it round underneath, to meet the point where the other ceased; these should cut through the fascia, and the whole should be separated from any attachment to the parts beneath, with the point of the knife, so as to admit of further retraction by the hands of the assistants. The muscles are then to be divided down to the bone, nearly in the direction of the first incision, and the femoral artery and profunda secured. The outer and under incisions are then to be made in the same way: the whole is to be separated from the bone,

and pressed upwards by common broad pieces of linen as retractors, assisted by the hands, whilst the bone is sawed through, which is done without difficulty, either from the out or inside, as may be most convenient to the surgeon. The pressure on the flaps made by the retractors and the hands of the assistants, as well as the compression on the artery against the os pubis, will prevent any hæmorrhage of consequence, while the bone is removing. The vessels are now to be secured according to their importance, even to the smallest that bleed; the stump should then be sponged with cold water, and well dried; the flaps are to be brought together, and retained by a suture in the middle, and good adhesive straps, the ligatures being brought out above, below, and directly forwards, as their course may point out. Compresses are to be laid upon the sides of the wound, and the whole supported by the bandage brought down for the purpose, but not made to press upon the surface of the stump.

When amputation by the circular incision is preferred, the tourniquet may be used to stop the circulation of the blood; and especially where the surgeon is not much accustomed to operative surgery, the assistants bad, and the loss of a larger quantity of blood than usual might prove fatal. It should however be completely slackened as soon as the principal vessels are secured; for the natural retraction of the muscles is prevented by the strap of the instrument, which often causes some difficulty in high operations, in sawing the bone, by preventing the retraction of the soft parts. In consequence of these, and other inconveniences attending the use of the tourniquet in operations high in the thigh, I recommend compression to be made on the artery against the os pubis, in preference; but this requires a self-confidence young operators do not in general possess; and, as they are taught to look for safety in a tourniquet, it is only practice will convince them of its frequent inutility, and constant disadvantage, in this particular place of operating; for, of the number of amputations at the middle of the thigh I have done, and seen done

under my direction, in few has the tourniquet effectually controlled the circulation, whilst pressure on the artery as it passes over the os pubis has invariably done it. The strap of the instrument may indeed occasionally compress the branches of the glutæal and sciatic arteries in the thigh, but they are really not worth consideration. I may add, that when I have performed the operation without a tourniquet, my patient has lost little blood, and that when I have used a tourniquet, I have frequently had considerable hæmorrhage; indeed I once lost an officer in consequence of hæmorrhage during the operation, although the tourniquet was in the charge of a surgeon of ability. In a case of this kind, where it is found of little benefit, the surgeon should not continue twisting and turning it, whilst his patient is bleeding, but quit it altogether, and compress the artery against the os pubis himself, giving, if necessary, the tenaculum to his assistant.

When the tourniquet is to be applied, the pad should be firm, and rather narrow, and carefully held directly over the artery, whilst the ends of the bandage in which it is contained are pinned on the thigh. The strap of the tourniquet is then to be put round the limb, the instrument itself being directly over the pad, with the screw entirely free. The strap is then to be drawn tight, and buckled on the outside, so as to prevent its slipping, and not to interfere with the screw, which is to be turned until the pressure is sufficiently strong to stop the circulation. If the screw require to be turned for more than half its number of turns to effect this, the strap is not sufficiently tight, or the pad has not been well applied; and they must be replaced.

The patient being placed as before, the assistants are carefully to retract the integuments upwards, and put them on the stretch downwards; by which means their division is more easily and regularly accomplished. The surgeon standing on the outside, passes his hand under the thigh, and round above quite to the outside; where he begins his incision with the heel of the knife, and with a quick steady movement carries it

round the thigh, until the circular division of the skin, cellular membrane, and fascia is completed. The knife is not to be held loosely in the hand, but firmly grasped, so that the operator may be aware of the force applied, and what will still be necessary to carry the incision fairly through the fascia; and I am the more particular on this point, because the skin cannot be sufficiently retracted unless the fascia be divided; and because I know this step of the operation is frequently neglected, or thought unnecessary, and the cellular substance separated from the fascia, instead of being retracted with it.

By beginning the incision towards the heel of the knife, an opportunity is allowed with the remaining part to cut what is left undivided, as far as regards the depth to which this incision should be carried; and gives a facility in completing the last two inches of the circular, by bringing up the point of the knife, when the bending of the wrist would hardly allow the lower part of it to be applied; and as the division of the skin is certainly the most painful part of the operation, it ought never to be done by two incisions, when the largest thigh can most readily and speedily be encircled by one.

If the fascia should not be completely divided by the first circular incision, it is to be cut with the point of the knife, and at the same time any attachment to the bone or muscles beneath is to be separated, to allow of its complete retraction; and on the under part, where it is attached to the bone, it will always require this assistance. The amputating knife is then to be applied close to the retracted fascia and integuments, and the outermost muscles are to be divided by a circular incision, with any portion of the fascia that may not have equally retracted. This incision completed, the knife is immediately to be placed close to the edge of the muscular fibres which have retracted, and the remainder of the soft parts divided to the bone in the same manner. In making these two incisions, and I consider two and sometimes three necessary, I would mark well the usual course of the great artery, and care should be taken to cut at least half an inch on each side of it

by one incision, which should be either the first or second, as may be most convenient; and this caution, however trifling it may appear, will, to young operators, in the facility of securing the vessels, bring its own reward. The muscles attached to the bone are to be then separated with a scalpel, for about three inches at least in large thighs, by which means the bone will be fairly imbedded when sawed off. The common linen retractor is now to be placed on the limb, and the muscles steadily kept back while the bone is sawed through. The periosteum is to be divided by one circular of the scalpel, after the retractor is put on; the heel of the saw is then to be applied, and drawn towards the surgeon, so as to mark the bone, in which furrow he will continue to cut, with long and steady strokes, the point of the saw slanting downwards almost in a perpendicular direction, until the bone be nearly divided, when the saw is to be lightly pressed upon, to avoid splintering it, which this manner of sawing will also tend to prevent. During this operation, the thigh should be held steadily above, and in such manner below, that the part to be cut off does not weigh on the bone above; at the same time it must not be pressed inwards, or upwards, or it will prevent the motion of the saw, or splinter the bone.

The retractor is to be removed, the great artery is to be pulled out by a tenaculum passed through its sides, separated a little from its attachments, and firmly tied with a two-threaded strong ligature (provided the dentist silk is not used and the ligatures cut short), and the tenaculum is not to be withdrawn until this is accomplished. Any other vessels that show themselves may be secured, and compression should for an instant be taken off the artery, when others will start. The tourniquet should now be removed, and the small remaining vessels will be discovered. If the great vein continues to bleed, after some pressure has been made upon it, a single-threaded ligature should be put over it; but this should not be done if it can be avoided, and only when the loss of a little blood might be dangerous. If the cancellated

part of the bone should bleed freely, the thumb of the left hand pressed steadily upon it, whilst the vessels are tying, will in a short time suppress it. Any inequality of bone should be removed by the forceps; the ligatures, if they are to remain, should now be shortened, one end of each thread being always cut off at the knot, when the vessel is secured. The stump is to be sponged with cold water and dried, the bandage rolled steadily down the thigh, the muscles and integuments brought forward, and placed in apposition horizontally across the face of the stump, and retained by adhesive plaisters carefully applied, from below upwards, and from above downwards. The ligatures being brought out nearly as straight as possible, in two or three places between the slips of plaister, a little dressing is to be placed over them, a compress of lint, two slips of bandage in the form of a Malta cross, vertically and horizontally, and the whole secured by a few more turns of the bandage. No stump cap is to be applied; the stump is to be raised a little from the bed in which the patient lies on his back, and if the bone appears to press too much against the upper flap, the body may be a little raised, which will relieve it.

In secondary amputation of the thigh, the integuments may not be sound, and will not retract; here they must be dissected back to an equal distance all round. If the muscles are much diminished in size, or flabby, they should be left even longer than may appear necessary for the formation of a good stump; and this is to be done more especially on the under part, for bone will frequently protrude under these circumstances, when enough has been supposed to have been preserved. In all these cases the bone should be short, and the skin should, if possible, retain its attachments to the parts beneath. I have never seen an inconvenience arise from too much muscle and skin in a circular stump; but I have frequently seen it from too much loose skin.

In primary operations, there will be from three to seven vessels to be tied; in secondary ones, from ten to sixteen, and

even then there may be an oozing from the stump. In this case a little delay in searching for the vessels is necessary; the tourniquet and all tight bandage shoud be removed, and the stump well sponged with cold water, before it is dressed. A certain degree of oozing is to be expected from all stumps, although it does not always occur; but when there is really any hæmorrhage, so that blood distils freely through the dressings, the stump must be opened, when the bleeding vessel will generally be readily discovered, although not before visible.

When the operation is performed near the knee, the gradual thickening of the thigh prevents the retraction of the integuments, and has an effect on the vessels of the stump; both of which evils are avoided after the circular incision is completed, by making a little cut of an inch and a half in length in the integuments, through the fascia on each side, in the horizontal direction in which they are recommended to be placed, after the operation is finished; but this will very rarely be necessary.

When the operation is performed in the middle of the thigh, the femoral artery will be found on the upper part of the stump, a little above, and to the inside of the bone, between the sartorius and the triceps muscles; lower down in the thigh it will be on a level with the bone; and about one third of the distance above the knee, it will be on the inside, and rather below the level of the bone; its round white open mouth will in general mark its situation, on the first inspection of the stump.

In secondary amputations, where the parts are diseased, it will not only be useless, but dangerous, to attempt to unite them by the adhesive inflammation. The roller should be well and carefully applied from the upper part of the thigh to the edge of the stump, the integuments may be supported over the face of it by one or two straps of plaister, and simple dressing; and when due suppuration and granulation have taken place, compression may be made use of, by adhesive plaister and bandage, to accelerate the cure. Where union is

not likely to take place, as in diseased parts, or in operations performed from necessity, at an improper period, the ligatures should be cut away close to the artery, and allowed to drop off in the discharge. In all these cases, the bone should be at least an inch shorter than it is usually recommended to be made.

The dressings should generally remain until the fourth day. In hot weather, or when union does not take place, and there is much discharge, it may be necessary to change them on the third. To facilitate their removal, a poultice may be applied for an hour or two previously to attempting it, or, what is better, the stump should be well moistened with warm water, dropped upon it by squeezing a wet sponge over its upper surface. The bandage and compress will then be easily removed; and during this dressing an assistant should support the parts, so as to prevent any separation of those lately united; indeed, a stump should always be dressed by two persons, one to change the applications, the other to support and bring forward the parts. The plaisters need not always be changed at the first dressing, one end only being raised, and the matter wiped away; and when they are all changed, they should not all be removed at the same time, but as two are taken off one should be put on, to prevent any separation from the weight of the unsupported parts. The hand of the assistant should, in an especial manner, prevent this, and assist in pressing out any matter, from behind forwards, which may be retained between the flaps, or has collected on the face of the stump. The ligatures may be gently pulled upon about the seventh or eighth day; but no force should be used or pain excited for several days afterwards, and then only with great caution.

In the first edition, I recommended the flap operation to be done at the upper part of the thigh, in preference to the circular incision; I have found, however, since that period, that it is not so easily accomplished by those who are not accustomed to operative surgery; and I now advise, in all cases, except that of amputation at the hip-joint, that the common

mode of operating should supersede it, unless it appears that a longer stump can be saved by making flaps, in consequence of some of the soft parts being destroyed. The operations in domestic surgery generally allow of a choice of parts, and then the operation by the circular incision is the most simple: the principal point is to cut the bone short between the trochanters. I have performed the operation six times lately in London by this method, and made in all excellent stumps.

In amputation by the circular incision, some discussion has taken place with reference to the division of the muscles, as to the best mode of making a good stump; and the method of doing it is supposed to have great influence on this point.

Mr. S. Cooper, in his First Lines of the Practice of Surgery, Vol. II, 1820, has taken some pains to point out to whom the various improvements are due; but still the subject has not, I conceive, been met with that boldness which ought to mark every proceeding in surgery. The general occurrence of bad stumps, according to the ancient method of operating by cutting down at once to the bone, was scarcely avoided until after the time of Mr. Alanson, whom I have already mentioned, page 208, as having introduced the greatest improvements in his method of operating. It is true, that before his time Cheselden and Petit* had done something to render it less dangerous, in recommending two incisions to be made, instead of cutting down to the bone at once; and Petit had even laid down the great, although subsequently neglected principle, on which success depends, "To cut away as much of the bone, but as little of the flesh, as possible." Alanson added to this an oblique division of the muscles, and the immediate closure of the stump to procure adhesion, which is the real improvement, and not the oblique division of the muscles, as is often supposed. Louis, in France, paid great attention to this subject also, and the result of his observations may be found in three papers in the Mémoires de l'Académie de Chi-

* J. L. Petit, Traité des Maladies Chirurgicales, tome iii, page 150.

rurgie, to which I have already alluded, page 305. He observed, that the muscles of the thigh did not all retract to an equal extent when divided; that the long muscles retracted most, and those which were attached to the thigh-bone the least. In order to render the cut surface regular, he conceived the idea of cutting the muscles longer or shorter according to their capabilities for retraction, and in this manner to equalize them. With this view, he made a circular incision through the muscles, going no deeper than the long and loose muscles; and when these had retracted in consequence of the division, he divided the fixed ones by a second incision close to the retracted edge of the first; and in this manner he conceived he cut them nearly of equal lengths.

Mr. Hey, in his Surgical Observations, recommends three incisions to be made, and with the same view as M. Louis; but to cut the posterior muscles the longest, he thinks the second circular incision ought to be made at twice; and he directs the bone to be sawed through at the place where the last cut through the fixed muscles is made. His words are, "And thirdly, another incision through that part of the muscular flesh which adheres to the bone, made round *that part of the bone where the saw is to be applied.*" The directions given by Louis hardly deviate from this, and the object of all seems to have been to form a regular cone, the apex of which should be the bone, to which I object, it being necessary, in my opinion, to have the apex considerably depressed, or elongated.

Many surgeons have endeavoured to adopt and combine both methods, from finding, perhaps, that neither was alone sufficient. Thus Richter, Hey, and others, have urged the impossibility of cutting in the manner Mr. Alanson recommended: "The integuments being divided by a circular wound, the knife is to be applied, close to the margin of the retracted skin, upon the inner edge of the vastus internus, and at one stroke an incision is to be made obliquely through the muscles, upward in respect to the limb, and down to the

bone: in other words, the cut is to be made in such a direction as to lay the bone bare, about two or three finger-breadths higher than a perpendicular incision would do. The operator is now to draw the knife towards himself, so that its point may rest upon the bone, still observing to keep the instrument in the same oblique position, in order that the muscles may be divided all round the limb in that direction, by a proper turn of the knife. During the performance of this movement, the point of the knife is to be kept in contact with the bone, round which it of course must revolve." It is sufficient to say that the directions here given cannot be complied with, and that Mr. Alanson never could have performed the operation in this manner. He wished to do so, and therefore did as nearly as possible, and supposed he had done it; for if any one will try, he will find it impracticable. Surgeons seem by mutual consent to have acknowledged this; and cutting simply, but in a slanting direction, whether by one or two incisions, was substituted for it. The object of cutting in a slanting direction is to obtain a cone with a greater degree of correctness, so that when the parts are approximated they may be found to be in complete apposition. This is all well, abstractedly considered: but the principal point has been overlooked, that if parts are cut on mathematical principles they must be brought in contact with mathematical precision, if any good be desired from it; and if the unequal retraction of living parts be considered, independently of other circumstances, I do not believe one man will be found, who can suppose that the object to be gained is really accomplished. In the next place, the incision is not made in the manner intended, and the surgeon deceives himself if he thinks it is; for, although it may be begun in a slanting direction, the knife is brought so nearly, if not, on most occasions, so entirely into the straight position by the time it reaches the under part of the thigh, that the principal part of the incision is made without any inclination upwards. I do not intend to say that this cannot be done, but only that it is *not* done; of

which any one may convince himself by examining the cut end of any of the muscles on the under part of the thigh after an operation professedly done in this manner, but without any previous knowledge on the part of the operator of such examination being intended. I have now to add, that this slanting cut may be attempted if surgeons think it looks well, but that it is of no consequence whatever, if it be not effected.

With regard to the unequal contraction of the muscles, the case is something different, although it is also not clearly stated. The long muscles can only contract to any extent, when they are at liberty, and not bound down by the tourniquet, which is usually applied so tight as to compress the small branches of the glutæal and sciatic arteries. That it does this, is an advantage which its advocates contend for in its use; and if it do this, it must at the same time so compress the long muscles as to prevent their retraction, and therefore must do away, in a great degree, the object intended to be gained by this mode of operating. When a tourniquet is not applied, the long muscles are retracted much more than the fixed ones, and they ought therefore to be divided separately, which is the reason why I have recommended, on the principle of M. Louis, two incisions to be made through the muscles. In regard to the first incision, which is to divide only the long and loose muscles, it ought to be distinctly understood, that as they are not all of the same thickness, or disposed in an equally thick layer around the thigh, they cannot be divided with that precision which theory would imply to be the case: some are frequently only partially cut, and in other places the fixed muscles may be injured. In the first case the surgeon should accomplish, by an additional incision where required, what he had left undone; but it is much better even to cut a part of the fixed muscles by the first incision, than to make several strokes with the knife in order to divide the different long muscles which have been left uncut. The pain attendant on the cut in the fixed muscles is consentaneous with that of the general incision, and therefore not

distinguishable from it. It would be certainly desirable never to cut more or less than is absolutely necessary; but this cannot always be done, and it is therefore an error of less consequence to cut a muscle which must afterwards be divided, than to have to make a separate incision to complete that which has only been begun, because the pain in the former case is not augmented, whilst in the latter it is actually renewed. The retraction of the long muscles, during the operation, certainly assists in forming a good stump, provided it be properly attended to. The continuance of the retraction after the operation, on the other hand, tends to make a conical stump, and is therefore to be counteracted; this is to be done by bandage during the period of cure, and by gaining, during the operation, a cushion from the fixed muscles, in addition to the covering obtained from the integuments, and long or loose ones, which is only to be accomplished by dissecting away the fixed muscles from the bone, which necessarily ensures a sufficient covering of fixed muscles, loose muscles, and integuments. It is the great step of the operation to be attended to; with it, a bad stump *cannot* be made; without it, a good one can scarcely be made.

Mr. Hey, in that part of his book which treats of amputation, says, that where the circumference of the thigh is twelve inches, the integuments are to be divided three inches below where the bone is to be sawed. I have no hesitation in saying that it ought to be nearer four inches, to ensure a good stump, and the addition should be made in the latter part of the operation, or that of separating the fixed muscles from the bone. Some difference of opinion has also arisen as to how much of the integuments is to be saved previously to cutting the muscles. Loder* says, that in a small limb, half an inch will be enough, and that in a large limb an inch or more will be sufficient; but the terms here specified should at least be doubled, for the surgeon may be assured, that if the inte-

* J. C. Loder, Chirurgische Medicinische Beobachtungen, p. 6. Weimar, 1794.

guments are on the stretch the muscles will be absorbed, and a conical stump will be the result, unless the bone has been cut very short. If the limb should have been amputated on account of disease of the bone and its periosteum, it is possible that on some occasions it may not be entirely removed, and the disease goes on in the stump. It is, however, a much more frequent consequence of splitting the bone in the act of separating it by the saw, or of baring the bone of its periosteum previously to its application; and I have several times removed bone thus destroyed by necrosis as high as the trochanter, after the usual process of separation had taken place. An operation is seldom necessary, except it be to detach the sequestrum from the surrounding parts, after it is loose. Where proper care and attention are paid, another amputation will seldom be necessary or advisable, and only when the constitution of the patient is unequal to sustain for a longer period the local irritation.

Amputation of the Leg.

This operation has not, I think, been of such frequent occurrence as that of the thigh. This arises from the nature of wounds from cannon-shot, which generally strike near the knee, from wounds by musket-balls attended with fracture being more manageable, and in general less extensive, than in the thigh; and perhaps from an error which is generally current, that when the stump cannot be left at least four inches long below the knee, it had better be removed above; which usually decides, in cases of secondary amputation, in favour of the operation on the thigh.

It does not often happen that cannon-shot strike the leg without destroying it, or doing so much injury as to render amputation necessary; but there are many serious wounds from shot or shells that do not require this operation.

If the calf of the leg be in part torn away without injury to the bones, it would be improper to amputate on the

field of battle; for cases of this kind occasionally do well, although after a tedious treatment. If, in addition to the injury of the soft parts, the tibialis postica and peroneal arteries be divided, amputation should be performed, and the knee-joint preserved, which might by delay be implicated in the disease.

A piece of a shell, from the sharpness of its edges, sometimes causes more of a lacerated than a contused wound when it strikes the calf of the leg, considerable hæmorrhage will ensue, and the parts appear tumid with blood; here the appearance of the wound should not alone be attended to, it should be carefully examined, and if the tibia be sound, it may yet do well; the wound should be cleared from blood, any vessels of importance secured, and the result awaited under the most vigorous antiphlogistic treatment, and the constant application of cold water to the seat of injury.

If the tibia be broken with a wound of this kind, amputation is absolutely necessary. The fibula, however, may be broken, and a piece carried away with considerable injury to the soft parts of the leg, and the patient preserve a useful limb; injuries, therefore, of this kind admit of delay.

Wounds from musket-balls do not in general fracture both bones; and so much advantage is obtained from the support of the fibula, and the superficial situation of the tibia, that very considerable fractures of it may be successfully treated; the danger being greatest in the vicinity of the joints.

A fracture of the tibia alone, with a wound of the anterior or posterior tibial artery by the same ball, does not authorize amputation, unless the limb be stuffed with blood; and the incisions necessary to secure both ends of the bleeding vessel, leave, in addition to the fracture, so great an extent of injury, that there will be little or no probability of success.

When both bones are seriously fractured, with a wounded posterior tibial artery that cannot be secured on moderate search, or the limb be injected with blood, amputation is the best remedy to prevent further evil. With a wound of the

anterior tibial artery, an effort should be made to save the limb.

If the tibia and fibula be broken in two places, by two distinct musket-balls, which have passed through the leg, it will, I believe, be better to amputate; for, although it might be saved (and I have saved limbs under an injury of this kind), it would be a useless inconvenient member, which the patient, after some months of pain and uneasiness, would most readily part with. I recollect one case in particular, after the battle of Roliça, in which the leg was shattered in two places at the same moment. Six months afterwards, I saw the man with his wounds quite closed, and his limb straight; but it was a burthen to him he was willing to lose, after having sacrificed his health in the endeavour to preserve it.

A wound from a musket-ball, which passes through the thick part of the tibia, below the level of the tuberosity, and injures the articulation of the head of the fibula, allowing the bones to bend and grate immediately below the knee, is very dangerous; for it will always, more or less, implicate the joint, and frequently terminate in amputation or death. It is not a case absolutely requiring amputation in young and healthy subjects, in the same manner as when the joint itself is injured, until every effort to preserve the limb by the means already recommended have proved unavailing; but in elderly men, who have drank hard, or have been free livers, with bad constitutions, or who have been many years in tropical climates, I recommend immediate amputation; for I do not recollect a case doing well in such persons, but have, on the contrary, seen almost all of them terminate fatally in a few days, from the great constitutional irritation.

Wounds of the ankle-joint from gun-shot are extremely dangerous, and in general require amputation. The success that has attended the treatment of compound dislocations of this joint, has induced many surgeons, unmindful of the nature of gun-shot wounds, on the field of battle, and the circumstances in which soldiers are generally placed afterwards,

to believe, that the foot may be saved at the expense of an anchylosis between the tibia and astragalus; and cases have not been wanting to confirm this supposition, even when parts of the articulating surfaces of these bones have been extracted from the wound. But for every case of this kind that has recovered, nine have died, or have preserved their lives by submitting to amputation. It is not the local injury alone that destroys the patient, but the constitutional irritation which ensues, and which is only removed by the amputation. In comparing these cases, it should not be forgotten, that the gun-shot wound has destroyed a great part of the articulating surface of the bone itself; whilst the compound dislocation has in general done little more than injure the ligaments.

Musket-balls, or grape-shot, striking near the joint, or lodging in its vicinity with injury to the capsular ligament, require only to be removed, and the most strict antiphlogistic regimen, and the application of cold to be enjoined. If the capsular ligament be a little more injured, or the tibia, or astragalus, in part fractured, the same plan should be adopted to its greatest extent, and amputation only resorted to, when it can no longer be avoided. But if a musket-ball, or grape-shot, passes fairly through the ankle-joint, the case is widely different; if the tibia and astragalus be both fractured, and destroyed in the track of the ball, with other injury usually attendant on such accidents, the joint will not do well; it will anchylose but in very few instances, and, to attain these, many lives must be sacrificed. If the shot should have passed laterally through the joint, with destruction of the lower head of the fibula, thereby including the three bones, amputation is necessary without delay. If the astragalus only be injured, the limb may be saved, and a certain degree of motion preserved in the other joints of the foot.

When it is likely that the necessary strict attention cannot be paid after a battle, to wounds of the ankle-joint, with fracture of the bones of any kind, it is much better to amputate the leg on the spot; whereby much constitutional injury

will be avoided, and the patient at the end of six weeks be a healthy man, instead of then undergoing an operation with considerable hazard.

In cases of officers, or where there are but few wounded, and every attention can be paid, and where the tibia and fibula are not injured at the same time, delay is proper, to see what nature can effect; and it need hardly be added, that when amputation is not performed at first, it is not to be resorted to afterwards, until it is necessary to relieve the constitution from an injury, the effects of which it can no longer sustain.

Amputation of the leg is performed in two ways; by the circular incision, and by the flap operation: the circular incision being most applicable to the fleshy part of the leg about the calf; the flap operation, to the lower and tendinous part near the ankle, where sufficient integument and muscle cannot be obtained, to make a good cushion for the bones in the usual manner.

The latter operation has been recommended, with the view of preserving a long stump, to which an artificial foot might be attached, and the deformity and inconvenience caused by the operation, obviated as much as possible by art. In private life, it is certainly a very great advantage to many, who are able to procure the necessary machinery. In the army, this is not granted, and the soldier is discharged, with a common wooden leg, on which the stump is stretched out behind; and his circumstances in life seldom afterwards permit his purchasing an artificial foot, although he retains the perfect use of the knee. Here the good intentions of the surgeon are not only completely frustrated, but they prove prejudicial; for the length of stump behind is always inconvenient, and often gives rise to accidents, attended with much pain and distress.

In France the flap operation is never practised; and although the injury requiring amputation be at the ankle, they cut off the limb about four inches below the knee; and in so doing, they

say they render their patients more comfortable, and better able to get their livelihood, than if they left them a long stump, intended for a foot they can never acquire.

This point should then be settled by the patient; for it is the duty of a surgeon to give the best assistance of art, and to enable those committed to his care to obtain their future subsistence with the greatest ease and advantage to themselves. It is an operation that will not permit of any motion after its performance, as its success depends, in a great measure, on the due adhesion of the flap, forming thereby a convenient cushion and covering for the stump. When the patient must be removed any distance after the operation, it is better to do it higher up, when he will be comparatively but little inconvenienced.

In elderly men, who are not likely to make use of an artificial foot, or in people who have reached that time of life, that they do not think the trouble of acquiring the habit of walking with it, compensated by its advantages; or in labouring men who follow no trade, or cannot procure the machinery, the operation near the knee is preferable. In soldiers suffering from, or subject to scrofula, I would also recommend it.

The operation by the circular incision is performed in the thick part of the leg; and the bone is usually sawed through about four inches from the patella, that, when the stump is healed, there may be sufficient length of bone left to support with steadiness the weight of the body; and that greater facility may be given to the motion of the leg, from the preservation of the insertions of the flexor tendons.

The most eligible place for the application of the tourniquet, is about one-third of the length of the thigh from the knee, on the inside, where the artery perforates the tendon of the triceps muscle, and where it can be most conveniently compressed against the bone, by a small firm pad, the instrument being on the outside, or opposite the pad; or the compress may be placed between the hamstring tendons, a little

distance from the hollow behind the joint, the instrument itself being on the fore part of the thigh. In this method, the pad must be thicker, and the compression is more painful, and not more secure.

The surgeon should stand on the inside of the leg to be operated upon, that he may more readily saw the fibula at the same time as the tibia, by which the chance of splintering the fibula is diminished; for this bone is held much more steadily under the saw when the tibia is undivided, whatever pains may otherwise be taken by the assistants to secure it. The limb should be a little bent, and the circular incision made with the smaller amputating knife through the skin and integuments to the bone, on the fore part, and to the muscles on the outside and back part; and as the attachment of the skin to the bone will not readily allow of its retraction, it must be dissected back all round, and separated from the fascia, the division of which in the first incision would avail nothing, from its strong attachments to the parts beneath. The muscles are then to be cut through, nearly on a level with the first incision, and down to the bones. The interosseous ligament between the tibia and fibula is to be divided with the catlin; and as several of the muscles cannot retract, in consequence of their attachments to the bones, they are to be separated with the knife; and in the same manner the intermuscular septa, or expansions running between them, are to be divided, as they will still prevent their retraction. The retractor with three slips is now to be put on, the centre slip running between the bones; by which the soft parts may be pulled back to a sufficient distance, any adhering part being divided by the point of the knife. The bones are to be sawed through with the usual precautions, and the retractor removed, when the three principal arteries should be secured: the anterior tibial, on the fore part of the interosseous ligament, between the tibia and fibula; the peroneal artery behind the fibula; and the posterior tibial near it, more inwards and behind the tibia; this artery will frequently, however, contract very much,

and only shows itself on the compression being taken off the artery above; it in general causes more trouble to secure it than the others, and I have two or three times seen the needle dipped around it in despair, when, merely pulling out the artery with the tenaculum, and dissecting a little round it, would have shown the small retracted bleeding vessels arising from it, and have prevented, in all probability, a secondary hæmorrhage. The tourniquet being removed, the smaller vessels tied, and the stump sponged with cold water and dried, the integuments and muscles should be brought forward as much as possible, and the straps of adhesive plaister applied from side to side; that is, the wound is to be closed vertically, or nearly so, that the straps of plaister may not in any way press upon the fore part of the tibia; by which the protrusion of it will be avoided, an occurrence which almost invariably follows when the line of approximation is horizontal, and the straps of plaister press upon the bone. Although this method of closing the wound is recommended by gentlemen of authority in the profession, I am satisfied it is very unsafe. When the wound is dressed in the way recommended, a sufficient covering of muscle and integument is obtained for the formation of a good stump, which heals in a very short time, and is completely cured, as I have seen in many instances, in less than a month. An error is often committed by young operators, in detaching too much skin after the first incision; whereby a pouch is formed that collects the discharge, and retards the cure. If the spine of the tibia be very sharp, it should be removed by the saw.

In the British army the operation has principally been performed after this method; for, when the nature of the wound has precluded the possibility of amputating lower down than two inches and a half below the tuberosity of the tibia, the limb has often been removed above the knee, from the idea that an operation, so close to the joint, might cause it to be affected with inflammation. It was also supposed, that so small a portion of the tibia would rather be of disservice, the at-

tachment of the flexor tendons being for the most part removed; and that when a fracture extended so far up as to prevent the leg being amputated at the usual place of election, the injury would in all probability have affected the joint.

Further experience proves these opinions to be erroneous, and has shown, that when the limb is amputated nearer the tuberosity, no bad consequence ensues to the joint, provided it was not originally affected; the motion of the thigh, as dependent on the action of the flexor muscles of the leg, is not entirely lost; and, what is of more importance, the direct progressive motion of the thigh is preserved.

Our own countryman, Mr. Bromfield*, and latterly Messrs. Larrey and Garrigues in France, have amputated at and immediately below the tuberosity, with success; and I have myself frequently done it much within the place of election; but the Baron Larrey, to whom the credit of introducing it into the French military practice is due, and to whom I am indebted for my immediate acquaintance with it, declares he has not met, after repeated trials, any of the evils usually represented as attending its performance; and that it is not more dangerous than the operation at the usual place of election, provided the bone be not sawed higher than the level of the tuberosity of the tibia, or, at farthest, immediately below the insertion of the ligament of the patella. He says†, "A transverse line, drawn directly outwards on the level of the tuberosity of the tibia, generally runs below the articulation of the fibula with the tibia, and below the thickest part of the head of the bone; but as the relative situation of the tuberosity of the tibia, and the head of the fibula, is not constant, the tuberosity must be always considered as the point above which the saw must not be applied; for, on cutting above it, the attachment of the ligament of the patella is cut off, the bursa mucosa beneath it is opened into, and fre-

* See page 185 of his Chirurgical Observations and Cases.

† See Mémoires et Campagnes de Chirurgie Militaire, tome iii, page 391.

quently the capsular ligament itself, from which the most serious symptoms may arise, affecting the life of the patient, or rendering amputation of the thigh necessary. By not cutting above the level of the tuberosity, the attachment of the ligament of the patella is preserved, as well as of the flexors of the leg, the capsular ligament is uninjured, and the head of the tibia is cut sufficiently low to obviate the fear of caries.

"The advantages of this operation are very great when compared with that of the thigh, which it is intended to supersede in all such wounds of the leg in which it is practicable. The danger of the operation is less; it is not more difficult in its performance than any other; and the stump heals as readily as in the thigh. I have never seen caries of the bone occur; on the contrary, the cicatrix has readily formed over it without any evident exfoliation. When the fibula is left short, which is usually the case, it is to be extirpated as useless and troublesome in the application of the artificial leg, and the skin is to be left as long as possible, to cover the stump.

"The stump, including the knee, and one or two finger's breadth of the tibia, forms a solid support for the body in the erect position, and enables the patient to walk without difficulty, and without the aid of a stick. The shortness of the stump, which is bent backwards, readily permits the adaptation of an artificial leg, as it does not extend beyond the calf; in which it may be included with as much advantage to the patient in the movement of the limb, as if the operation had been performed above the ankle."

In cases, then, where the injury done to the bone does not extend into the knee-joint, this operation may be performed instead of amputation of the thigh, care being taken that the saw is applied below the tuberosity of the tibia, the prominence of which is readily felt on the fore part of the bone. The skin, in these cases, must be sound for a sufficient distance below, to form a covering for the stump; and when the injury is so close to the knee as to render it uncertain whether

it extend into it or not, an incision should be made on the tibia, to ascertain this circumstance, and it need not interfere with the operation, if found to be practicable.

I saw the operation performed, with great dexterity, by the Baron Larrey, in the Hospital of the Imperial Guards at Paris; and I also saw two persons, who had each lost a leg in this way, walking with a wooden one with great ease, and without the aid of a stick.

In this operation the tourniquet is to be applied where the artery perforates the tendon of the triceps, and not in the ham. The circular incision of the integuments is to be made in the usual manner, and the skin turned back; the muscles on the under part and outside are then to be divided and cleared from the bones, which are to be sawed off, the retractor having been used to prevent injury to the muscles. The parts around the fibula are now to be separated from it, and the small amputating knife, on account of its strength and the ease with which it is managed, applied close to the upper edge of the head of the fibula, which, by a little inclined motion of the hand, may be easily cut from its articulation with the tibia. The large artery or arteries will be found in the ham retracted behind the head of the bone, from whence they must be pulled out and fairly secured, as well as any muscular branches that may bleed. The nerves are to be shortened, if they happen to be longer than the stump. The removal of the fibula allows the integuments to be readily brought down diagonally over the stump, and muscle can be found to cover a part of it on the under and outer side; the upper part can only be covered by the integuments, but I think this would unite as readily as it does lower down, under nearly similar circumstances. The French surgeons, however, merely bring the parts over the stump by the circular bandage, and dress it from the bottom with lint, until granulations form; when they endeavour, by circular compression and bandage, to approximate the parts and procure cicatrization, making an incision through the integuments perpendicular to the spine of

the tibia, to prevent its protrusion; and in a number of instances in which M. Larrey has performed it, he says, he has never failed.

I performed the operation in the York Hospital, in the year 1817, in the manner I have directed, with complete success, and before a great many students, who were perfectly satisfied with the result. It is possible, however, that a case may occur (perhaps one in a thousand) in which the head of the fibula communicates with the general cavity of the knee-joint; in such a case, amputation must be done above the knee.

Baron Larrey, who, in my opinion, deserves much credit for this operation, has, in his estimation of its value, discredited the flap amputation lower down, and I think unjustly; for it is in many instances a valuable operation, and not exposed to the accidents he is inclined to attribute to it. In France it has been very little tried, because, as an operation in military surgery, it did not succeed; in England it is commonly practised; and in the British army, when well done, and under favourable circumstances, has proved very successful, but requiring a greater degree of attention on the part of the surgeon than the one performed higher up.

It appears to be an operation, even in England, that has been practised more from necessity than choice; to have been disused at one period, and again brought forward from a conviction of its utility, as may be collected from the works of Messrs. O'Halloran*, White†, and Bromfield‡. Mr. Hey§, who has contributed very much to the improvement of this operation, gives the following description of its performance, to which, as I have little to add, I prefer giving it nearly in his own words:—

"To ascertain, with precision, the place where the bones of the leg are to be divided with the saw, together with the length and breadth of the flap, I draw upon the limb five

* See O'Halloran on Gangrene.
† White's Surgery.
‡ Bromfield's Chirurgical Treatises.
§ Hey's Surgery.

lines, three of them circular and two longitudinal. The situation of these lines is determined in the following manner: I first measure the length of the leg from the knee to the ankle; that is, from the highest part of the tibia to the middle of the inferior protuberance of the fibula. At the midway between these two joints, I make the first, or highest, circular mark upon the leg: this mark is to point out the place where the bones are to be sawed through. At this mark also I measure the circumference of the leg, and thence determine the length and breadth of the flaps, each of which is to be equal to one-third of the circumference. In measuring the circumference of the limb, I make use of a piece of marked tape or riband, and place the extremity of this measure upon the anterior edge of the tibia. I will suppose the circumference to be twelve inches, in which case I make a dot in the circular mark on each side of the leg, at the distance of four inches from the anterior edge of the tibia. It is evident that these dots will be found four inches distant from each other, when the measure is applied to the posterior part of the leg. From each of these dots I draw a straight line downwards four inches in length, and parallel to the anterior edge of the tibia. These lines mark the course which the catlin is to take in the formation of the flap. At the extremity of these lines I make a second circular mark upon the leg, which points out the place where the flap is to terminate. Lastly, I make a third circular mark, at the distance of an inch below the superior one which was first made, which intermediate mark is designed to direct the circular incision, through the integuments on the anterior part of the limb. The course and extent of the different incisions being thus marked out, the operation may be performed with the greatest precision.

"The catlin which is used for the purpose of making the flap, ought to be longer than those which are commonly made for a case of instruments, and I push it through the leg, a little below the place where the transverse incision is to be made of those muscles which are not included in the flaps.

Having placed the limb in a position nearly horizontal, with the fibula upwards and the knee bent, I push the catlin through the leg at *d*, and carry it downwards, along the course of the longitudinal marks, till it approaches the lowest circular mark, which it joins in the course of the curved line, and the incision then terminates a little below the inferior circular line, *e c*.

" The flap being held back, I divide the integuments on the anterior part of the limb along the course of the circular mark, *b d*. There is always a considerable retraction of the skin after it is divided, if the integuments are in a sound state, and if a proper allowance were not made for this retraction, the extremity of the tibia would be left uncovered, and the flap could not be applied with so much ease to the patient, nor with a certainty of an union by the adhesive process.

" The muscles which are not included in the flap, are then divided transversely a little below the place where the bones are to be sawn through; but no great quantity of muscular flesh can be conveniently preserved below the extremity of the divided bones, on account of the adhesion of the muscles to the bones; nor is it necessary, as the flap, when made in the middle of the leg, contains a portion of the gastrocnemius and soleus muscles, sufficient to make a good cushion for the extremity of the bones.

" When the bones are sawn through, it is advisable to cut off a little of the extremity of the conjoined flat tendon of the gastrocnemius and soleus muscles, as it is apt to project beyond the skin when the flap is placed in its proper situation.

" The large crural nerve is frequently found lying upon the inner surface of the flap. It should then always be dissected out, and when gently extended, should be divided near the extremity of the stump. By this method it will retire so far as to suffer no compression from the flap."

I have frequently succeeded in this operation, but it requires much attention in the after-dressing, that the flap may

be properly supported, or the spine of the tibia will protrude, causing ulceration of the skin above; a protrusion of the end of the fibula on the side of the flap will also sometimes occur, both of which inconveniences may be avoided in military practice, where the attention paid, during the cure, can seldom be so great as in private life, and where the patient is often obliged to be removed some distance after the operation, by sawing the fibula at first half an inch shorter than the tibia, and by then sawing off, in a slanting direction, the sharp spine of the tibia; when the skin may be laid down upon it without fear of its coming through.

I consider sutures, one on each side to support the flap, as indispensable: for I have always found the straps of plaister alone insufficient and painful. They should be applied diagonally, to avoid pressure on the spine of the tibia. The sutures may be cut away on the sixth or seventh day after the operation, or they will in a short time ulcerate themselves out.

It is of the greatest importance that the flap be well supported at all times during the cure, and especially for the first fortnight, whilst changing the dressings; for, if it be allowed to depend upon the adhesions it may have formed without proper support of bandage and position, the operation will fail, and a bad stump, tedious of cure, will be the consequence.

I recommend this method in all its steps to young operators, for when they depend upon the eye alone, they are often in error, and I have seen some very bad stumps the consequence of it; but the catlin necessary for this operation not being contained in military cases of instruments, I have generally performed the operation with the smaller amputating knife; and as the directions and marks above related are a little tedious, I have formed the flap by the eye, according to the size of the limb; and in doing this, the knife is to cut obliquely inwards and upwards, the same kind of flap that the catlin would cut outwards, taking care to have it rather too long than too short: and this method I prefer, even if the

measurement be taken, as the flap is then more equally made, for the catlin frequently cuts out more of the muscle than is necessary, and which must afterwards be removed. The incision on the back part being completed, the knife is to be drawn circularly over the bones, so as to join the two angles of the flap; the undivided muscles are then to be cut through in the direction of the last incision, separated from their attachment to the bone, the retractor applied, and the bones sawed through as before, the fibula being shorter than the tibia, and the sharp spine of the tibia being removed. The vessels being secured and the nerve cut short, the flap is to be brought up, and a suture made on each side. The straps of plaister should be so applied as not to press upon the tibia; the muscles of the calf of the leg should be well bandaged down from above the knee, and the flap always supported until firm union has taken place; and while this process is going on, the surgeon should carefully prevent protrusion of either bone, or ulceration of the integuments over them from any unequal pressure.

Those persons who have suffered amputation of the leg below the knee, and are obliged to rest upon it in order to walk, frequently suffer considerable inconvenience, and sometimes great pain, from the chafing of the skin of the part against which the pressure is made. It is very desirable, with many, to know how these evils may be prevented; and although they may not perhaps be entirely removed, I am sure they will be greatly obviated by attention to the following means of prevention. The cushion on which the knee rests should be made of cloth stuffed with unravelled worsted, which ought to be examined and teazed out every third day. The knee itself should be covered by a cap made of chamois leather, and fixed on behind the knee with tape or riband. The inside of the leather should be spread or rubbed over with pure bees-wax, which ought to be renewed once a week; and the only inconvenience attending this is, that the leather becomes hard and requires frequent renewal.

When it is intended to wear an artificial leg and foot, the stump should, if possible, be seven inches long; when a common wooden one is to be used, it should not exceed four.

The knee or stump ought to fit firmly, but not too tightly, into the wooden leg.

Amputation of the Foot and Toes.

Wounds of the feet seldom occur from cannon-shot, without encroaching so much on the ankle as to render amputation by the last-described operation necessary; but the end of the foot is occasionally injured by cannon-shot, or shells, so as to required amputation at the joints of the tarsus and metatarsus, or the metatarsus and the toes: both these operations are of infrequent occurrence in military surgery, as injuries requiring amputation seldom include more than one or two of the toes, or they destroy a considerable part of the foot.

The feet generally suffer from wounds of musket-balls; and as the parts in the foot, although bearing a general resemblance to the hand, are more complex and difficult of management, so are wounds of the foot more dangerous, and more generally followed by defective cures, from apparently slighter causes. The treatment of these injuries requires greater attention, and more aid from surgery, than is called for in other parts; for a musket-ball will seldom pass through the foot without injuring a joint of some kind, or wounding a tendon or nerve; and the injury to the fascia, which is very strong on the sole of the foot, and frequently covered by much thickened integument, is always attended with inconvenience. The extraction of balls, of splinters of bone, of pieces of cloth, and the discharge of matter, become more difficult, and often cause so much disease as ultimately to render amputation of the foot necessary. Tetanus is a frequent consequence of these injuries, and is a disease in its acute form remediable by no operation or medicine that I am acquainted with. Lame-

ness is also frequently the result, even under more favourable circumstances.

Wounds of the foot require at first most particular examination, whether amputation be supposed necessary or not; and all operations of this kind likely to be required afterwards should not be deferred until they cannot be dispensed with; but the necessity for doing them should, if possible, be superseded. The operative surgery of the foot should be done as soon after the injury as can be conveniently accomplished, for a large, clean, incised wound is a safe one, compared with a torn surface and splintered bone, with extraneous substances of much less extent; and as a ball lodged in the foot is always very dangerous, greater attention should be paid in the examination even in slight wounds; for, although the opening be apparently too small to permit a ball to pass in, still I have several times known one found at a later period, and the most serious consequences ensue from its not having been discovered sooner. Vide case, page 173.

A cannon-shot can seldom strike the foot without destroying it altogether; it may, however, merely strike the heel, and destroy a considerable part of the os calcis, without rendering amputation necessary, if the ankle-joint be untouched; for, by due attention in removing the spiculæ of bone at first, and by making free openings for the discharge of matter in every direction in which it may appear inclined to insinuate itself, the limb may be preserved in something of a useful shape.

Wounds from cannon-shot injuring the fore part of the foot are better remedied by amputation at the joints of the tarsus with the metatarsus, than by sawing these bones across; but when the injury affects only one or two toes, they may be removed separately, recollecting that it is of greater importance to preserve the great toe than any other, and that this toe is worth preserving alone, when any one of the others would be rather troublesome than useful.

Musket-balls seldom, I believe, commit so much injury

as to require amputation as a primary operation, although they frequently render it necessary as a secondary one. To be able to judge if amputation be requisite, or indeed in the treatment of any severe wound of this kind, it will almost always be necessary to enlarge the original wound, which, from the position of the soldier, may be said to be on the upper part, or side of the foot. The splinters of bone are to be removed, the ball and extraneous substances are, if possible, to be taken out, and if the bones, tendons, and blood-vessels are so much injured as to render the attempt to preserve them useless, amputation is to be performed; but if the preservation of the limb be thought practicable, and it generally will be so in wounds from musket-balls, the attempt must be made under the most rigid antiphlogistic treatment, the local application of leeches and cold water from the first, and with free openings for the subsequent discharge.

Musket-balls seldom injure the metatarsal bones so much as to require their removal with their toes, and under the treatment above mentioned these wounds will in general be healed without further operation. Wounds from grape-shot occasionally render the removal of the metatarsal bone of the great toe at the tarsus necessary, although much should be done to save it. The little and adjacent toes are also sometimes removed at the tarsus; the middle ones but seldom, as it is not an easy operation to perform, in consequence of the naturally close attachment of these bones, and the additional compactness they have acquired from the pressure of the shoe. I have never performed this last operation, and I think the removal of the pieces of bone, with free openings for the discharge, will in general supersede the necessity of doing it in these cases.

In the consideration of amputation from wounds in any of these parts, it must be recollected, that wounds of the feet have less tendency to heal than elsewhere, and that this process is also more slow in elderly people; so that in an old man a wound may render amputation advisable, on the field of

battle, which in a young and healthy man might with propriety be deferred.

Hæmorrhage from the arteries of the foot authorizes in a very slight degree amputation, even when superadded to other causes; for the incisions necessary to secure the bleeding vessels will not in general add much to the original injury, unless they are very extensive; on the contrary, they will render the wound less complicated, and more manageable.

Amputation of the foot, performed with the view of removing tetanus, even when the original injury has been trifling, has completely failed in my hands. It is a very violent attempt to remove a disease that few people will submit to in the mild tetanus, and it has been useless in the acute, in all the cases in which I have tried it.

Amputation at the tarsus has been recommended and practised of late years in injuries of the foot, for which the leg was formerly amputated. It is not so common an operation as might be expected, and is performed as follows, when it is proposed to save the flap from the under part of the foot.

The joints of the metatarsus, with the tarsus, being well ascertained, an incision is to be made across the foot, in the direction of the joints, but from half to three quarters of an inch nearer the toes, and the integuments drawn back over the tarsus. From the extremities of this incision, two others are to be made along the sides of the great and little toe, for about two inches and a half, according to the thickness of the foot; and the ends of these two incisions are to be united by a transverse one down to the bone on the sole of the foot, the corners being rounded off, as in Plate III. The flap thus formed on the under part is to be dissected back from the metatarsal bones, including as much of the muscular parts as possible, as far as the under part of the joints of the tarsus. The metatarsal bones are now to be removed by cutting into and dislocating each joint from the side, commencing on the outside by placing the edge of the knife immediately above, but close to the projection made by the posterior part of the

metatarsal bone supporting the little toe, which prominence is always readily perceived. The arteries are to be secured; any long tendons and loose capsular ligament are to be removed with the knife or scissors, and the under flap formed from the sole of the foot is to be raised up so as to make a neat stump, when brought in contact with the upper portion of integuments that were first turned back; the whole to be retained in this position by sutures, adhesive plaister, and bandage.

When the skin of the under part of the foot is much torn, as may happen in a wound made by a piece of a shell, the flap cannot be formed from it: in this case it must be saved in a great measure from the upper part; but the integuments being here so much thinner, the flap is not so good a defence against external violence, and will be more readily affected by cold. I have seen the metatarsal bone sawn across in a straight line, in preference to removing them at the joint; and although the whole may be sawn across at once with more ease than any one of them individually, except the outer ones, still I do not think the stump can ever be so good, or so much protected from external violence, as when the operation is performed at the joint of the tarsus.

M. Chopart introduced another amputation of the greater part of the foot, which, although it has seldom been performed, seems likely to be of service. The object is to save the heel and the joint of the ankle, which he says form a stump more serviceable than a wooden leg. The operation is performed in the following manner: "The integuments are to be divided about two inches distant from the ankle-joint, transversely across the upper part of the foot. The extensor tendons and muscles in that situation are next to be cut, down to the convexity of the tarsus. A small incision is then to be made on each side, nearly at right angles with the extremities of the transverse one, commencing below and a little in front of each malleolus. A flap being thus formed, it is to be drawn upwards by the assistant, but not dissected backwards, the cel-

lular texture being so loose as readily to admit of its retraction. The joints formed between the os calcis and the os cuboides, and the astragalus with the scaphoides, are now to be opened, commencing with the latter, and the surgeon ought to attend particularly to the eminence on the inner edge of the foot, indicating the attachment of the tibialis anticus muscle to the inside of the os scaphoides, as a guide to the joint. The articulation between the os cuboides and the os calcis will be found nearly in the same transverse line, but rather obliquely forward. The ligaments being divided, the foot is to be pressed downwards, and a straight knife passed underneath the bones of the tarsus and the metatarsus, until it has separated from them a sufficient quantity of soft parts to make a flap, which when brought up will cover the wound on the fore part, and be in apposition with the edge of the integuments divided by the first incision. It ought to be retained in this situation by two sutures, and by adhesive plaisters, compress, and bandage, all of which should be applied from the heel upwards and forwards. The arteries are to be carefully secured, and there will in general be three requiring the ligature; the anterior tibial on the instep, and the external and internal plantar arteries in the sole of the foot."

In performing this operation care should be taken to make the under flap so large that the line of cicatrization may be on the upper and anterior edge of the stump, rather than transversely across the face of it, in order to render it firmer, and better able to resist and sustain any pressure which may be applied to it.

Lisfranc performs it in the following manner: — The limb being placed in its natural situation on the table, and held by an assistant, the surgeon ascertains the situation of the joint formed by the junction of the astragalus with the scaphoides, which will be indicated by the prominence on the inside of the tarsus, discoverable by passing the finger forwards from the malleolus internus towards the side of the great toe. The joint of the os cuboides with the os calcis on the outside is

always to be found about half an inch behind the projection formed by the posterior part of the metatarsal bone of the little toe. The under part of the foot being firmly held in the palm of the surgeon's hand, he places the point of the thumb on the external joint, and that of the fore-finger over the internal one, which indicate a transverse oblique line for the first incision, and which should commence near the thumb and be continued with a semilunar sweep, the convexity towards the toes, until it terminates at the side of the foot where the fore-finger was placed. The joint between the astragalus and scaphoides is now to be opened into by directing the knife from within obliquely outwards towards the projection of the metatarsal bone of the little toe. These bones are then to be dislocated by pressure, and the ligaments retaining them divided. The joint between the os cuboides and the os calcis is now to be opened from without inwards, and the bones dislocated: the strong interarticular ligament being cut and the joint largely opened, the knife is to be passed between the under surfaces of the scaphoides and cuboides, and the soft parts adhering to them; and cuts from behind forwards a flap sufficiently large to cover the wound, which is then to be dressed in the usual manner.

Richerand, in his Nosographie Chirurgicale, relates the particulars of one case in which he performed this operation, and the patient walked afterwards upon the stump, without crutches.

Amputation of a single metatarsal bone, on the out or inside of the foot, is generally recommended to be done by an incision round the root of the toe, terminating in a line on the outside of the foot, which is continued down to the joint of the tarsus. The integuments are turned back above and below from the metatarsal bone, which is to be dissected out with the toe attached to it, and the flaps brought together, so as to leave but one line of incision. This operation is delineated by Mr. C. Bell in his Operative Surgery, and it is the best way of doing it, where there is no injury or external

wound: but in military surgery there is always a wound; and when the removal of the bone is necessary, it is in general an extensive one, and with loss of substance, so that a covering cannot be saved in this way, especially on the upper part of the foot, where the ball or piece of shell strikes. The military surgeon must therefore be prepared to look for his covering on the under part, where he will occasionally not be able to procure it in sufficient quantity; and it must not be forgotten, that the neighbouring parts will often be injured. The object must then be to save the integuments from such parts as are uninjured, so as to cover in the wound as nearly as possible, when the bone is removed. In doing this, the first incision should commence at the upper and inside of the toe, and be carried round, so as to separate the toe from its attachment to its fellow. If the injury be entirely on the upper part, the continuation of this incision must be so regulated as to form the whole of the flap from below, and the commencement of it above must be continued round the injured part, so as to meet the lower end near the articulation of the bone with the tarsus, and vice versâ. If the ball has gone directly through, destroying the integuments above and below, the incisions must surround the injured part in such manner, on the upper and under side of the foot, as to allow the flaps to be formed in every other part, except where the injury was inflicted, and from whence granulations must arise. By saving skin everywhere else, the wound will be much diminished in size, will heal sooner, will be less liable to suffer from external violence, and less obnoxious to the subsequent pain, which always at intervals attends wounds of this kind.

Amputation of the phalanges of the toes is done in the same manner as of the fingers; but as these operations on the foot are by no means so common as on the hand, I shall reserve the description of them until I come to operations on that part.

Of Amputation at the Shoulder-Joint.

Anatomy, which has thrown so much light on operative surgery in general, has not failed in the last few years to dispel the cloud that obscured this part of surgery; and experience has proved it to be as simple, easy, and safe an operation, as any other of importance performed on the field of battle. The knowledge acquired from this source of its success, has given to military surgeons a confidence in performing it, that divests it of half its former terrors, and by removing from the mind of the patient the idea of his having suffered a hopeless operation, diminishes the subsequent danger, and most materially aids his recovery. The dread formerly entertained of this operation was very great, even by men of the best abilities: and under certain circumstances in domestic surgery it may still be tedious. It can never, however, again be considered formidable, except under bad management, and from extreme ignorance.

The distinction between the necessity of the operation, and the possibility of avoiding it, requires in many cases the exercise of the nicest judgment, and a due consideration of attending circumstances; for there is no part of military surgery, in which an operation can be performed with more advantage at the instant; or delayed for a few days, with a view of gaining information, with more prejudice; inasmuch as the necessary incisions are made, in the first instance, in parts disposed to take on healthy actions, and in the best possible state for undergoing surgical operations; the constitution of the patient being also at that moment generally good, and able to sustain the demands upon it under untoward circumstances; or of supporting, without future injury, the restraint and control requisite for the successful accomplishment of the cure.

The difference between cutting in sound and diseased parts is justly appreciated by every surgeon, both as to his personal convenience and ease in operating, as well as to the future

healing of the wound; and the advantage here is particularly great, as, from the contiguity of the wound to the chest and the principal organs of life, it is advisable to avoid any excess of action; and experience has demonstrated, that the evil to be apprehended from the equilibrium of the circulation being destroyed is infinitely less than it would be at a subsequent period of three or four weeks, after high suppurative action has been going on. It cannot be too strongly impressed on the mind, that the necessary examinations should take place, and the operation be performed in those cases demanding it, as soon after the injury as possible, consistent with the state of the patient; and the surgeon should not satisfy himself with the idea of being able to accomplish it as safely, or as successfully, when suppuration has been established, and when perhaps he may have better assistance at hand; a kind of self-deceit that is occasionally permitted, but which cannot be too much reprobated.

The importance of the arm is so great, and even a limited use of it so valuable, that much should be hazarded to save it, when there is a tolerably fair prospect of success: the situation also and structure of the upper extremity, together with the command the surgeon has over it, and the less proportionate inconvenience resulting from a severe wound in that part to any other of equal value, render its preservation after a serious injury more practicable, and less dangerous, than is frequently supposed. The operation should not, therefore, be performed, unless simple amputation by the flap operation cannot be successfully accomplished; or, where the limb is evidently destroyed, or the injury seriously affecting the articulation itself, while the general health of the patient, or the unfortunate circumstances of situation, render the attempt at a farther perseverance in saving the limb improper.

Injuries from musket-balls penetrating the capsular ligament, attended with fracture and destruction of the head and adjacent parts of the humerus, and wounding the axillary artery, require immediate operation. A simple penetrating or

incised wound of the joint, of small extent, does not call for any operation, as the patient, with due care, will escape with a certain degree of loss of motion, and of debility in the joint; nor is it proper in a wound from a musket-ball, where there is even some partial injury of the bone, as these cases frequently do well, and the patient preserves the use of the fore-arm.

There is, however, some difficulty in ascertaining this circumstance to have taken place, even with a careful examination, as sufficient injury may have occurred within the capsular ligament to cause the bone to exfoliate, without being so obvious as to be immediately detected, or to indicate the necessity of any operation; and as every exertion or motion of the part adds to the mischief already committed, it is advisable, even on the suspicion of such injury, to desist from further examination, and treat the case as a simple one; being one of those that ought to be deferred until the subsequent processes of nature have pointed out the extent of the mischief, and her inability to overcome it. A teasing inquiry into its nature may make a simple penetrating wound as dangerous as if it had been originally more extensive and complicated; and allowing a knowledge to be acquired, by a continuation of these attempts, of a greater injury, there is nothing gained to compensate for the inconvenience that will most probably be occasioned by the efforts attending it. On the other hand, if the wound and splinters of bone point out the head of the humerus to be totally destroyed, with fracture extending to its body, the operation ought to be performed, and the patient's future health preserved, in preference to the chance of an anchylosis taking place at the end of many months, with its destruction; for although some have recovered after such wounds, many more than a fair proportion have perished in the attempt at preservation. I have not performed the operation of amputation in consequence of a wound from a musket-ball; but, where one passes fairly through the head of the humerus, destroying its substance, the best practice will be either the re-

moval of the head of the bone, or the extremity; and in a person subject to scrofula, or where the greatest attention cannot be paid, there is little choice, amputation being the most advisable operation; for excision, under these circumstances, might possibly not prove successful. The capsular ligament surrounds the head of the humerus closely, and preserves its form even when considerably injured, so that the fulness of the shoulder is not much destroyed, unless there be considerable mischief done to the neck and body of the bone, as well as to its articulating surface; and it is only in a case of this kind, where injury is done to the head, neck, and body of the bone, and that by a large shot, that it can, or, I believe, ever does feel like a bag of sand under the deltoid muscle; and this is not a proper case for any other operation than amputation, for the injury must be very great. I have seen a ball pass through the head of the humerus, without materially destroying its shape, or injuring the capsular ligament, and yet the patient died from hæmorrhage, and large depôts of matter round the joint. It is not fracture of the bone alone that is the cause of the evil in cases of this kind; it is the inflammation of the capsular ligament and synovial membrane of the joint, which frequently follow even a simple incised wound, without fracture; and which will be kept up by a variety of causes, independently of the irritation of the bone, until it destroy the patient, if the whole of the diseased parts are not removed. I do not mean to deny, that cases can recover, even where the extensive injury above mentioned has occurred, and the injured parts only have been removed; but I am satisfied that the loss of lives, in military practice, will be comparatively great, and that when the injury extends in the length of the body of the bone, amputation is by far the safest remedy. In a severe injury of the head and neck of the humerus, the extent of which is uncertain, the surgeon should carefully examine the wound; if the splinters extend to the body of the bone, amputation should be performed: if

it be confined to the head and neck of the humerus, excision ought to be practised, as described under that head.

A wound from a musket-ball, causing a fracture beneath and exterior to the capsular ligament, although in its immediate vicinity, by no means demands amputation from this cause alone, unless a large portion of the bone, or surrounding integuments, be destroyed. With a wound from a musket-ball passing through the soft parts and the bone in the same situation, without destroying its substance to any great extent, the arm has frequently been preserved. The inflammation and suppuration are to be kept within bounds by due care, and the sufferer will have a chance of retaining an arm, which will be more or less perfect, according to the extent of injury and other attending circumstances ; and if the attempt prove unsuccessful, the operation is the last resource. If the brachial artery below the edge of the pectoral muscle be divided, in addition to the fracture of the bone, it makes the case more complicated, and will be, taking the extent of the injury and other circumstances into consideration, a sufficient cause for an operation. In a favourable case, however, where the bone is not much, or hardly splintered, the integuments not torn, or stuffed with effused blood, the artery should be laid bare by a small incision, and each end of the vessel tied ; which would be of little or no consequence superadded to the gun-shot wound ; and, in some instances, might facilitate its improvement, by the more ready removal of the spiculæ of bone. The principal danger does not arise in this instance from either the fractured bone, wounded artery, or the mischief likely to occur in the immediate seat of injury, but from the probability of gangrene taking place in the lower part of the extremity, from the anastomosing branches being unable to support the limb, under the additional pressure of the actions going on above. If then, even with the most favourable case (simple amputation of the arm not being practicable), the appearance of returning circulation in the hand should not be

evident after a few hours' delay, but, on the contrary, it gradually becomes colder and painful, with some subsequent numbness and flaccidity, and all the usual appearances of approaching gangrene, the operation should be immediately resorted to, before any inflammation of importance has taken place in the parts to be divided, or gangrene has established itself in the whole limb.

A wound from a piece of a shell, or cannon-shot, in which the humerus is broken, and splintered high up, requires the operation, not only from the nature of the fracture, which is frequently extensive, but from the destruction of the muscles and integuments rendering the preservation of the arm impossible; or the latter may be so much injured above a fracture of less extent, as to demand the removal of the whole, from the impracticability of preserving sufficient to cover the bone by the flap operation; or from the bone being splintered into the joint, or denuded of its periosteum.

A fracture of the bone, or a wound of the artery, are, however, the principal circumstances from which the decision is to be formed, inasmuch as a large portion of the muscular part of the shoulder may be carried away by a cannon shot, and the patient yet recover with a limited use of the joint. The fore and outer part of the deltoid muscle may be torn away by a round shot, and the capsular ligament so laid bare, that the movement of the head of the humerus in the glenoid cavity within it shall be very apparent; yet the operation will not be necessary from this cause alone, as at a favourable season, and in a good constitution, very little slough is frequently thrown off, from a wound of this kind, if treated in a proper manner. A fractured bone, in a case of this description, by cannon-shot, admits of no delay in the operation of excision or amputation.

A cannon-shot can but seldom strike the inside of the arm, without fracturing the bone, wounding the artery and vein, and destroying the muscles and integuments in such a manner as to authorize the removal of it by simple amputation; or

at the joint, according to the practicability or propriety of its performance: or, the less degree of mischief done to the arm is more than counterbalanced by that committed in the chest, the great extent of which may prevent the operation from motives of humanity. It will frequently happen, that the arm may be irrecoverably shattered, and the thorax partake in a less degree of the injury, there being only apparent some contusion or grazing of the skin; if low down, the elasticity of the false ribs may have prevented the integuments being much injured in appearance, although the blow has been violent; yet the force of the ball may have ruptured the liver or spleen; or, if higher up, perhaps fractured the ribs, in addition to a more severe contusion of the integuments. When these accidents occur, the symptoms arising from the wound or contusion of the trunk of the body are to be first considered; if, at the proper time for the performance of the operation, they do not indicate a speedy dissolution of the patient, or the prospect of such an event in two or three days, the operation ought to be performed, and a chance of recovery given to the sufferer which he would not have, the arm being retained, and the injury of the chest remaining the same. The danger to be apprehended in the more favourable cases, is from inflammation; and this will be rather diminished than increased by the operation, the immediate shock of which is readily borne: the danger of deferring it is manifest and certain, the injury committed in the thorax or abdomen is not ascertained, and its effects may be obviated. The loss of blood, during the operation, tends to prevent inflammation; and if the termination be unfavourable, it can only be a matter of regret for the sake of the individual, and not for the non-performance of a duty. If the cavity of the chest be laid open, or several ribs beaten in, or a stuffing of the lungs take place from a large ruptured blood-vessel, all of which circumstances are obvious and cannot be mistaken, the operation would be an unnecessary cruelty. A hæmorrhage of short duration, or the expectoration of blood in small quan-

tities, although very dangerous, is not to be considered as depriving the patient of a reasonable chance, as they frequently follow blows from more common causes, and from which many have recovered. If the operation be delayed to ascertain what injury may have been done to the chest, from the symptoms that will follow, the danger resulting from both will be increased from their mutual action upon the system; and when a knowledge is acquired of little mischief existing in the thorax, the operation cannot be performed with propriety, from the inflammation that has supervened; and the patient probably dies, when he would have recovered under a more decided mode of treatment.

A round shot or flat piece of a shell may strike the arm, rebounding from the ground, or when nearly exhausted in force, without breaking the skin, or only slightly; yet all the parts within may be so much injured as not to be able to recover themselves. The bone may be considerably broken or splintered, the muscles and nerves greatly contused; or the injury may not be quite so extensive, the bone may be merely fractured, and yet the soft parts so much destroyed as not to be able to carry on their usual actions; or a ruptured blood-vessel may, with a slight external wound, pour its blood between the muscles, and inject the arm nearly to double its size; all of which are causes that render an operation necessary, and require decision, as inflammation will come on in a short time, when the moment for operating will be lost.

Independently of accident in the field, the nature of which leaves no doubt on the mind of the surgeon of the propriety of the operation, there are many subsequent occurrences that may render it equally necessary.

Suppose, that some days after the infliction of an injury in the arm, near the head of the humerus, considered likely to do well, a hæmorrhage shall occur which cannot be suppressed by simple means; or which, after the necessary incisions have been made to secure the open vessel by ligature, leaves little hope of a successful issue; the operation must

then be resorted to: or, when it has been delayed, and the slough and loose pieces of bone are removed by the suppurative process, the extent of the injury shows the impossibility of preserving the arm; or, the health and strength of the patient may be unequal to carry on the actions required, or to sustain the irritation caused by the diseased parts; the judgment must in this case be formed according to the general principles of surgery, differing in no wise from a disease caused by other means.

The general appearance, strength, and health, must under the pressure of a severe wound suffer considerably; and the care of the surgeon is directed to prevent their sinking below what can be restored. The difficulty consists, in ascertaining how much can be suffered, and the patient still have sufficient force to bear the operation, and sustain the necessary actions for his final recovery. When the injury is not doing well, independently of the external appearances of the wound, the countenance of the patient becomes more anxious and pale, the centre of the cheeks has a hectic flush, the eyes sink, the general irritability increases, with constant pain in the parts affected; the appetite is greatly impaired, or the stomach even rejects its food; the fever is increased towards evening, the pulse quick, sharp, and weak, frequently 120 in a minute; the nights are restless, the skin for the most part hot and dry, except when towards morning, profuse perspirations break out; frequent diarrhœa, and partial cold sweats soon close this scene, unless relief be obtained in due time from the operation. A proportion of all these bad symptoms will occur in every severe wound from which people recover; but when, from a due consideration of all circumstances, it is supposed they can no longer be endured, the operation must be performed as a last resource, and particularly if the appearance of the wound also indicate the necessity; and it should be done without attempting to strengthen the patient previously to its performance, for the removal of the diseased parts will be found the chief restorative.

The manner of performing the operation must depend entirely on the situation of the wound. The directions, therefore, that are generally given for conducting it after any particular method, can only be occasionally useful, as the surgeon may not be able to select the parts to be divided or retained, but must decide according to circumstances. A correct knowledge of the relative situation of the parts concerned in the formation of the shoulder-joint will be his best assistant, and may prevent some mortifying reflections; for the success of the operation depends in a great measure, in any of the methods proposed, on preserving just as much of the surrounding muscles and integuments, as will cover the vacuity left after the separation of the humerus, and be as near as possible in contact, to afford the best chance of union by the first intention.

The articulation of the humerus with the glenoid cavity of the scapula, forms a joint moveable in every direction, confined by a strong capsular ligament, supported and retained in its position by the muscles around it, and having the great vessels and nerves passing on its inner and under side to be distributed to the arm. Eleven muscles surround, or are connected more or less with the shoulder, and must necessarily be divided: they are, proceeding from above outwards, the deltoides, supra-spinatus, infra-spinatus, teres minor, the long head of the triceps extensor cubiti, teres major, latissimus dorsi; on the anterior part, the pectoralis major, and, underneath this muscle, the biceps flexor cubiti, coraco-brachialis, and subscapularis.

The artery which supplies the upper extremity with blood is given off from the top of the arch of the aorta, on the right side, in a common trunk with the carotid; it then lies across the root of the neck, as it does on the left side, having been sent off as a separate trunk from the lower part of the arch of the aorta; the artery having passed outwards between the anterior and middle scalenus muscles, inclines downwards under the clavicle, and it is at this spot, where it comes out

between the scaleni muscles, that it can be compressed against the first rib with ease and certainty in the living body, when operations are required; the artery having passed under the clavicle, inclining outwards and sloping downwards, assumes the name of axillary, having the nerves above it, and the great vein before and to the inside; in this course it gives off several branches, which are more or less regular, but are not concerned in this operation.

When the artery has passed under the clavicle, it may be compressed against the second rib, but it is not so conveniently done, the instrument being more in the way of the operator. The artery in its passage to the edge of the pectoralis major, where it again changes its name for that of brachial, gives off,

1. The mammaria externa, generally in four branches, one only of which, the thoracica humeriana, rising up between the deltoid and the pectoral muscles, can give any trouble during the operation.

2. Scapularis externa, running towards the root of the coracoid process, and passing through the semilunar notch to the outer surface of the scapula; this branch is out of the way of the knife, except when injudicious attempts are made on the coracoid process.

3. The subscapularis, which is a large artery given off nearly opposite the neck of the scapula, and in all common operations is not exposed to injury; it attaches itself to the lower edge of the scapula, and divides into two great branches, both of which remain untouched when the operation is judiciously performed.

4. The arteria circumflexa posterior is given off below the subscapularis, at the distance frequently of nearly half an inch, sometimes however immediately with it; it is a large artery, passing backwards and outwards, between the lower edge of the subscapularis, and the upper edge of the teres major, lying close against the bone, between it and the long head of the triceps, and is largely distributed to the deltoid muscle and to the capsular ligament, and must be divided in the operation.

5. The arteria circumflexa anterior comes off at the same place as the former, or frequently arises from it, and is a much smaller vessel; it passes under the coraco-brachialis and short head of the biceps flexor cubiti towards the bone, and below the capsular ligament, where, anastomosing with branches from the circumflexa posterior, it is lost in the deltoid muscle and on the fore-part of the arm. The subclavian vein passes out of the chest anterior to the artery, having the anterior scalenus muscle between them; after it leaves the clavicle and becomes the axillary vein, it is still anterior to the artery, or nearer the integuments, the artery being underneath, and between it and the cervical nerves, forming the axillary plexus; it receives branches corresponding to those given off by the artery.

The nerves of the upper extremity have their origin from the four lower cervical, and the first dorsal nerves; they pass between the anterior and middle scaleni muscles into the axilla, but higher up than the artery, where, surrounding this vessel with their meshes, and forming the axillary plexus, it gives off seven branches—the supra-scapularis, circumflexus, cutaneus externus, radialis, ulnaris, muscularis, cutaneus internus: the last six are cut across in the operation.

There are also other nerves coming out from the intercostal spaces, which supply the integuments of the arm; but they are of no importance as far as regards this operation.

The axillary artery, vein, and nerves, are therefore protected from injury by the humerus externally, and two muscular folds laterally; on the fore-part, or anterior side formed by the integuments and pectoralis major; on the back part by the integuments, latissimus dorsi, and teres major; they are all surrounded by a fatty substance, and some absorbent glands.

The depth of the subclavian artery from the surface, and the protection afforded it by the clavicle, pectoral muscles, and integuments, and to the axillary artery by the anterior fold of the armpit, have been the cause of much alarm in the

performance of this operation; some surgeons having supposed, that an artery of the magnitude of the subclavian could not be effectually compressed through so thick a cushion; and that a degree of circulation existed that might be embarrassing to the operator, and dangerous to the patient. This fear of hæmorrhage had great weight with all who have written on the subject; and the generality of authors declared it to be a fearful and terrible operation, in consequence of the impression on their minds of the impossibility of commanding the flow of blood, and the mischief likely to ensue from any sudden movement of the body, or accidental derangement of the pressure; the attention of surgeons has therefore been frequently turned to a variety of instruments for compressing the subclavian artery, each holding out his own method as the most to be depended upon for this purpose; whilst others, more distrustful, have even proposed taking up the axillary artery as a preliminary step to the operation. When the minds of men were so much alarmed at the thought of the axillary artery pouring forth its blood, it is not surprising that every consideration should give place to the important one of attaining this object; the patient was therefore made to undergo an operation worse than useless, inasmuch as it cannot be effectually performed without more trouble and dissection than is required to complete the whole; and when done, is rather an inconvenience than an assistance, independently of the feelings of the patient, and the unnecessary suffering from a prolongation of the operation.

Experience in military surgery has taught us, that the division of the axillary artery is not to be dreaded, as it is readily secured and retained between the finger and thumb until a ligature can be put over it. From the same source, I have learned so little to fear an accident resulting from it, that I consider it in my own practice, of little consequence whether the vessel be compressed or not, prior to its division; indeed, I prefer feeling the pulsation of the artery, that I may be certain it is afterwards properly commanded. The axillary

artery does not throw out so much blood at each pulsation as has been conceived; the blood thus thrown out immediately declares its situation, and if the judgment be not obscured by the hurry of the moment, very little pressure with the closed hand on the surface of the wound commands the hæmorrhage, until the operator is prepared to tie the artery: for, when it is divided, it shrinks amongst the surrounding nerves, and if not in full action, requires some little search before it can be discovered, as must have been observed by many in performing amputation at, or near, the shoulder-joint. I have even been obliged to take some pains in dissecting for the mouth of the artery in a simple flap operation, where the head of the humerus remained in the glenoid cavity, before the contraction of the vessel would allow of its being discovered; and frequently I have seen the tourniquet removed in a high operation, and all pressure taken off for some time, before the artery could be fairly drawn out, or made to bleed. Whenever a good assistant is to be obtained, it is advisable not to employ a tourniquet in any operation on the upper extremity, except under particular circumstances of extreme debility on the part of the patient. The surgeon must, indeed, entirely divest himself of all fear of hæmorrhage from the axillary artery; and while he is willing to receive any assistance that may be at hand, he must be prepared, in case of accident, to compress the vessel with one hand, and finish his operation with the other. Having his mind free from the apprehension of danger resulting from hæmorrhage, he will proceed to the operation with confidence, and will be surprised to find how little formidable it is in reality, compared with the general opinion that has so long existed of its immediate danger; for the subclavian artery can be compressed most effectually, and the operation in a healthy subject, free from previous disease of the parts to be divided, may be accomplished with less loss of blood than in a simple amputation of the arm only.

The most convenient instrument for compressing the ar-

tery, is formed of the common screw tourniquet of the capital case of instruments, the handle of which should be made even, as the new ones generally are, or if curved, a little lint must be wound round in the form of the figure ∞ horizontally, to fill up the inequalities; a small fold of linen or lint is laid upon this, to take off the sharpness of the edges, and the strap partly folded over to keep it tight, as in the usual method of packing up a tourniquet in the case; the remainder of the strap is then twisted round to secure it, leaving a firm narrow compress, incapable of hurting the skin, and yet sufficient for compressing the artery. The thick end of the tourniquet is conveniently held in the hand, and allows as much force to be used with ease as can ever be necessary. I consider this mode of applying pressure preferable to the thumb or finger of the best assistant, as a greater force may be used with more ease and certainty on a larger space directly across the vessel; for the necessity of commanding the flow of blood is in general so impressed upon the minds of all, and the exertion consequently made so great, that the hand is tired before the moment of dividing the artery arrives, and the compression is probably imperfect, when it is alone necessary. This instrument also gives a greater extent of pressure, if any accidental circumstance or movement of the patient should alter his situation with regard to the assistant; and I can also state, that it so perfectly fulfils its object, that when properly applied, not one drop of blood will issue from the artery on its division. Compression may be made either above or below the clavicle, as the circumstances of the case render it most convenient. As there can no longer be a doubt of the possibility of compressing the subclavian artery above the clavicle, without inconvenience to the patient, and with perfect safety, it becomes the most eligible place, as the assistant, who performs this duty, is out of the way of the operator, and has the complete command of his instrument, and the artery. The cessation of the pulsation of the artery in the axilla, is a proof that the instrument is properly applied, and that the

circulation is interrupted; as a general rule, however, about midway between the acromion process and the sternum, will be the place where the compression should be made above the clavicle, and I have never known it fail with the instrument recommended: below the clavicle it should be from a quarter to half an inch more outward, nearer to the acromion; or the direction Camper has given may be observed, "that if the shoulder be thrown back, and compression made upon the axillary artery with the finger between the clavicle, the coracoid process, and the pectoral muscle, the pulse instantly ceases, and is only observable on removing the pressure."

Surgery is indebted to the French for this operation, as it appears to have originated with them; the first clear statement of its occurrence is referrible to the elder Le Dran, who performed it on the Marquis de Coetmadeu, and allowing for the precautions taken on account of the artery, appears to have done it extremely well, the wound having healed with a small cicatrix in the course of ten weeks.

Garangeot followed Le Dran with the same precautions with regard to the artery; but considering that it was the state of the integuments that frequently decided the mode of operating, he recommended the formation of a flap above, by commencing the incision three fingers' breadth below the acromion, across the deltoid muscle; and then forming another on the inside and under part to go over and meet the upper one when laid down, by the approximation of which the wound might be diminished in size and more readily healed; and this idea of Garangeot's should be kept in mind most particularly by military surgeons, as the utility of it will frequently come under their observation in practice. La Faye, in his paper on Amputation at the Shoulder-Joint, in the 2d volume of the Memoirs of the Royal Academy of Surgery, in France, recommends the whole of the flap to be formed on the upper part of the shoulder by the integuments and deltoid muscle; he says, "I make a transverse incision with a common straight bistoury about three or four fingers' breadth be-

low the acromion, across the deltoid muscle down to the bone: I then make two others between two and three fingers in width, on the fore and back part of the arm, to fall perpendicularly on the first transverse incision, so as to form a sort of flap; under which, having separated it, I pass the knife to cut the heads of the biceps muscle, and the capsular ligament: drawing the head of the bone towards me, and disengaging it with the bistoury, I cut from one side to the other, and between the bone and flesh of the armpit which sustains the vessels, carefully keeping the cutting edge of the instrument towards the bone. I then tie the vessels as near the armpit as possible, and separate the arm a finger's breadth below the ligature; the flap being brought down, covers the glenoid cavity of the scapula, and leaves merely a semicircular wound." He then adds, that since he read his paper in the year 1740, many celebrated surgeons had adopted this method, and practised it with success. He also mentions, that Le Dran, jun., in his Treatise on Operations, recommends that the ligature should not be made until after the arm is totally separated, but disapproves of the proposal as liable to some inconveniences which are avoided by his method; now these inconveniences could only be the fear of hæmorrhage, and if Le Dran did ever perform the operation as La Faye says he recommended, and as he states himself to have done, he was a bolder surgeon in this respect than very many of his successors. Sabatier, in his description of La Faye's method, says the flap is to be made of the shape of a trapezium, from which I apprehend the perpendicular incisions are made to approach each other gradually on the transverse line; but more modern surgeons have discontinued this transverse incision, gradually rounding off the lower end of the perpendicular ones, so as to make them meet in a semicircular form below; and this practice prevails with many surgeons.

Sharp's operation, commencing with an incision from the vicinity of the acromion down to the armpit, about two inches below the joint and through the pectoral muscle, to

enable the operator to put a ligature on the vessels with more care, and then continued round the joint in a circular manner, has, I believe, never been practised.

Bromfield* recommends the flap to be formed nearly in a semilunar shape, the inner point commencing over the tendon of the pectoralis major, passing a little below the termination of the deltoid, and ascending as high as the external fold of the armpit. He then makes a perpendicular incision from the acromion process through the deltoid down to the transverse incision, a little below its insertion, dividing thereby the flap into two portions, taking care to leave the outer one the larger of the two; the artery and vein are to be separately secured by a double ligature passed under them, between which they are divided; the nerves are to be cut shorter than the vessels, and the arm then removed from the body.

Alanson performed the operation in the following manner, by candlelight, in a case of gun-shot wound of the arm, in the year 1774†. "The patient was placed upon a table of convenient height, covered with a double blanket, and the shoulder brought off the side of the table sufficiently to give room for the operator's hand and knife; and the requisite pressure was made upon the subclavian artery, by the fingers of a judicious assistant. A circular incision was made about a hand's breadth below the acromion, and carried through the skin and membrana adiposa round the arm; the deltoid and posterior muscles were divided obliquely up to the capsular ligament; this was much facilitated by an assistant drawing up the skin with his fingers. I then divided the tendon of the biceps muscle and the capsular ligament upon the anterior and posterior part of the joint; after which an arterial branch discharged so freely, that we were convinced the pressure upon the subclavian artery was not effectual, although judiciously made; therefore I tied this vessel with

* Chirurgical Observations, p. 248.

† See Alanson's Practical Observations on Amputation, &c. p. 184.

the assistance of the tenaculum, and determined to finish the operation in the following manner: — To divide the tendon of the pectoralis major, the capsular ligament all round, and the rest of the parts, except the artery, veins, nerves, and cellular substance immediately adjacent; and as it was very difficult by so obscure a light to distinguish these parts so accurately as to be able to tie the blood-vessels, and cut through the nerves higher up, as directed by Mr. Bromfield, I included the whole in a temporary ligature, held just tight enough to prevent hæmorrhage; below this the parts were divided, which finished the operation, that is, separated the limb; after which the artery and veins being drawn out together by the tenaculum, and included in the same ligature, the temporary one was removed."

" Integuments being thus saved all round, they were approximated in such a manner as to form a line of division across the face of the stump, the ligatures brought out at the angle next the chest, and the wound dressed as in general use at present." At page 193, he confesses, that although he accomplished his operation with only a circular incision, yet it was executed with some difficulty, and would have been more readily performed by Bromfield's perpendicular incision from the acromion. He thinks, however, that the greater exclusion of air from the cavity of the joint, by the circular incision, counterbalances the difficulty; but he did not recollect, or was not aware, that this, or nearly similar incisions, heal in general by the first intention.

The French surgeons in the early part of the late war, improving from the frequent necessity of performing this operation, gradually rounded off Bromfield's angular flaps; and the Baron Larrey* uses a straight sharp-pointed knife, which he passes through the arm on the outside, close to the bone, and forms his outer flap, clearing it backwards, so as to expose fully the joint, into which he then cuts from behind

* Tome ii, page 170, de Chirurgie Militaire.

upwards, carrying the arm forwards and inwards over the breast, to enable him to divide the capsular ligament and surrounding tendons; he then grasps with his left hand the parts on the inside for the inner flap, taking care to include the axillary artery, to prevent hæmorrhage: passing his knife behind the head of the humerus, and keeping its edge turned as much as possible towards the bone, he forms the flap, and with it completes the separation of the arm from the body; by which means he avoids wounding the axillary artery, or cutting it too high, so as to render the application of the ligature inconvenient. He does not remove the cartilage from the glenoid cavity, and prefers having the flaps short; he does not lay them down with the idea of adhesion by the first intention, but approximates them by means of a gentle compress and bandage, dressing the wound from the bottom, and at a subsequent period promoting union and consolidation by the usual means.

When the state of the integuments will permit of a choice, I consider them to be preserved in the most advantageous manner after this plan, but differ in some respects in the mode of performing the operation (although I consider his method a very good one), and in dressing the wound afterwards; my idea being to lay down the parts immediately, as clean and as fairly divided as possible, with the view of obtaining adhesion, or of considerably contracting the wound; and I think the operation is rendered perfectly easy, and free from any danger, by the following method, even for surgeons of limited capacity; for the artery, the great cause of dread to all, may be secured before the last incision without even being divided, and the successive steps of the operation point out the respective situation of parts, and prevent the errors that are frequently made by cutting unadvisedly.

It is now time to correct another misapprehension that the fear of hæmorrhage has introduced into this operation; I allude to the idea prevalent amongst many surgeons, that it is to be performed in a different manner from any other of im-

portance ; that, instead of the calm, steady determination that distinguishes a surgeon of ability, who feels himfelf master of his subject, he is to forget or lay aside, what on all other occasions is considered most valuable, and endeavour to attain a peculiar precipitation and haste of manner, that is excluded from all other parts of surgery. There is still a practical point usually overlooked, that in military surgery there is little or no arm left to use as a lever in facilitating the operation, and that the separation of the head of the bone depends upon the surgeon, and not upon the assistants.

The patient should be placed on a seat lower than the surgeon (in the field an hospital pannier is the best); and so supported that he may not be able to slide off during the operation, the assistant in charge of the tourniquet, or instrument described, standing behind, and regulating the support in such manner that he may always be able to make steady compression when required. The shattered arm or stump is then to be raised from the body, sufficiently to enable the hand of the operator to examine the axilla, and ascertain that his assistant can compress the artery when he pleases; for this simple motion of raising the arm to nearly a right angle with the body, to afford access to the axilla after the pressure is made, will frequently render some alteration of it necessary. The arm should be also raised, so as to point out more clearly the insertion of the pectoralis major, and the posterior fold of the armpit, and as being more convenient to the operator, who, placing his finger on the lower end of the acromion process in the centre of the shoulder (the hair in the axilla having been previously removed), with the smaller amputating knife commences his incision immediately below it, and with a gentle curve carries it downwards and inwards through the integuments only, a little below the anterior fold of the armpit, and which the raising of the arm readily points out. The second incision outwards is made after the same manner, but something lower down, and is continued so as to show the long head of the triceps at the under edge of the deltoid,

without dividing any of the muscular fibres; by which means the skin has time and freedom to retract, which is a great object, being the part in general most wanted, and when retracted allows of subsequent extension. The third incision commencing at the same point as the first, but following the margin of the retracted skin, divides the deltoid on that side to the bone, and exposes the insertion of the pectoralis major, which must be completely cut through, to show the short head of the biceps flexor cubiti, and the coraco-brachialis, which are then readily known by their longitudinal fibres, and the freedom the arm or stump receives from losing its attachment to the fore part of the chest: these two muscles, however, are not to be touched, although the flap thus formed is to be separated, and raised so as to expose the head of the bone, nearly as far as the coracoid process of the scapula. The fourth incision outwards, in the same manner divides the deltoid muscle down to the bone, and extending to the long head of the triceps, which it is not necessary to touch, as it would be afterwards divided: this flap is to be well turned back, so as to show the insertions of the teres minor and infra-spinatus, coming across horizontally from the scapula, to be inserted into the great tuberosity of the humerus; the posterior circumflex artery will be divided close to the bone, the anterior circumflex, and the continuation of the thoracica humeriana on the integuments of the arm, and some other small vessels, may bleed, if the compression be not correctly applied; they ought not however to be tied, but merely commanded by the finger, and particularly the posterior circumflex, as this must again be divided, and pressure on the subclavian readily suppresses the hæmorrhage. Both the outer and inner flaps being now raised, the head of the bone may be rolled a little outwards, and the teres minor and infra-spinatus cut across upon it with a large scalpel, opening at the same time into the cavity of the joint; by which means the error of slitting up the bursa under the acromion, instead of the capsular ligament, will be avoided; and continuing the

incision upwards, cutting through the capsular ligaments, the tendon of the supra-spinatus, and the long head of the biceps flexor cubiti as close as possible to the edge of the glenoid cavity. The surgeon placing his fingers on the head of the bone, cuts through the inner side of the capsular ligament, and with it the subscapularis muscle, going to be inserted into the lesser tuberosity of the humerus. The edge of the knife being constantly towards the bone, he divides the under part of the ligament, separating the head of the bone from the glenoid cavity: resuming the small amputating knife, he cuts through the long head of the triceps, and with one sweep connects the points of the two first incisions underneath, separating the arm from the body, dividing again the circumflex arteries above the first incision, the teres major, latissimus dorsi, coraco-brachialis, long head of the triceps, axillary artery, veins, and nerves. This being the only dangerous step of the operation, the surgeon should inform himself if the artery be sufficiently compressed, which he will know by the posterior circumflex artery not bleeding, and the want of pulsation in the axilla: he should caution the assistant to preserve the steady position of the patient, and be ready to press his closed hand upon the artery, if it should bleed. Laying down the knife, he takes the artery, if bleeding, between the finger and thumb; or if compressed pulls it out with a tenaculum, and ties it firmly. The vessel is found contracted amongst the nerves in the lower third of the wound; all pressure being removed, the anterior and posterior circumflex arteries will bleed, and must be secured; or if the artery subdivides high up, there may be a fourth large branch; or the surgeon taking the parts to be divided between the fingers, cuts through them slowly until the artery comes into view, when a ligature may be easily placed upon it, and all danger avoided.

In recent cases of injury I have seldom had occasion to take up more than three arteries, and no cutaneous or other vessels, besides those divided by the last incision. The

nerves, if hanging in the wound, must be shortened, which will prevent irritation taking place hereafter from their adhering in the neighbourhood of the cicatrix. The axillary vein, if it continue to bleed to any extent and beyond a reasonable time, may be secured with a single thread, as it allows some blood to pass into the wound after it has been brought together, and, what is of more material consequence, permits it to pass into the loose cellular membrane surrounding the vessels down to the clavicle, which may cause considerable mischief, as the position of the patient is favourable to its gravitation.

All compression having been taken off the artery, the wound should be well cleansed, and here a little delay may be allowed. If the tendon of the long head of the biceps flexor cubiti be left long, it ought to be cut off with the scissors, as well as any ragged portions of the capsular ligament. The glenoid cavity need not be deprived of its cartilage. The pectoralis major will be observed to have retracted considerably, and to have doubled or folded in the skin covering it; through this (the parts being brought together), a suture should be put to the opposite side, if it appear to be necessary, and the whole properly supported and compressed by strips of adhesive plaister and bandage. The incision then forms but one line from the acromion downwards, curving at the bottom to the fore part of the chest, the skin at the axilla being always a little wrinkled, and much inclined to retract. The flaps of the deltoid meet firmly, sink a little into the hollow under the acromion, lie close upon the glenoid cavity and the coracoid process; and from the pressure of the adhesive plaister and compress, with the evenness of the wound, the skin of this part nearly unites by the first intention; the hollow round the glenoid cavity is comparatively small to what might be expected, and the consolidation in healthy subjects, where every thing has done well, goes on steadily, so as not to leave any cause for future inconvenience. The surgeon, in all his dressings, should take care that no

collection forms, by keeping up a regular and proper compression in the course of the artery, the coracoid process, the pectoralis major, and the muscles from the scapula and back.

I have insisted on the arm being raised from the first, because, in all operations that require the principal artery to be compressed, it should not be done until the limb be placed in the situation in which the operation is intended to be performed, for the mere alteration of posture removes the pressure from its destined point, as must frequently have been observed, when the tourniquet is applied without this caution in the axilla or thigh. This elevation also allows more freedom to the knife in every direction, and points out more clearly the situation of parts. I beg, however, to be understood as not recommending the arm to be raised in secondary cases, when there is partial anchylosis, or thickening of the ligaments, or other fair obstacles to its being done with ease to the patient.

It is not necessary to lay bare the acromion; on the contrary, the finger should be placed immediately upon it, to ensure the first incision being near half an inch below it, if the eye of the operator be not a sufficient guide; the flaps turn aside sufficiently without it, the head of the humerus is extricated with equal ease, and there is no subsequent danger, if the stump should slough, of the acromion coming through, and being a future inconvenience to the patient.

In making the last incision of separation, care should be taken to save as much of the integuments as the nature of the operation will admit; and this is done by keeping the head of the bone as far from the glenoid cavity as the attachment of the teres major and latissimus dorsi will allow, and by then cutting as close to the bone as possible. The long head of the triceps muscle is divided before the last incision, to prevent its hanging too long in the wound, and interfering with the approximation of the integuments. The anterior and posterior circumflex arteries require only a single thread; the latter will be divided about three quarters of an inch

from its origin, and the axillary artery in general near an inch from where it gives off the subscapularis.

On the principle, that the processes of bone with the cartilage of the glenoid cavity are in the way of the adhesion of parts, and that the removal of them facilitates the cure, by preventing the collections of matter and the formation of disease in and about the joint, which have in the end, it is said, frequently proved fatal; it has been proposed to remove a part of the acromion and coracoid processes of the scapula, with the whole of the cartilaginous surface of the glenoid cavity, as an improvement upon the more simple operation.

It cannot be expected that the inside of the deltoid muscle will adhere to the cartilage of the glenoid cavity. In the more trifling operation of removing a phalanx of the finger a little fluid is generally collected between the cartilage and the united integuments, where the operation has succeeded by the first intention, which remains some time while the cartilage is removing by absorption, previously to the integuments adhering to the bone; and in the amputation of the shoulder, where there is no external communication, in consequence of the adhesion of the parts around the scapula, the same process must go on, but is considerably shortened where this communication is regularly kept up, and is generally complete in from six to twelve weeks, as has been proved in a very great number of operations that have been performed in the Peninsula and in Flanders, where the cartilage was not removed; and in not one case has any evil consequence of this kind occurred, although several of them, for a longer period, have had a small discharge from the neighbourhood of the joint, but then only when the flap operation was performed. The glenoid cavity cannot, however, be scraped by any common operation in such a manner as to render it a surface to which the deltoid muscle can, or is likely to adhere, in the same way as the muscles and integuments do to the femur, unless it be intended to place the bone in the same situation, by also sawing off the articulating surface of the scapula itself,

which I can hardly conceive to be intended in a military operation, on a healthy subject, free from scrofulous disease of the joint.

Where there has been much previous disease in the joint, the recurrence of it should rather be attributed to other causes than the cartilage alone, or what will become of the operation recommended for the removal of the articulating ends of bones, where the cartilage and capsular ligament are left entire, and under much more unfavourable circumstances? Instances are given of the recovery of patients who have undergone these operations, and they must either be given up on this particular objection above all others, or the cartilage and remaining portion of capsular ligament must not bear all the blame of the ill success of the operation. There can be no doubt that as much as possible of the capsular ligament should be removed, on account of the synovia that might continue to be secreted from it, and its disinclination to unite with other parts. The glenoid cavity may be even pared if it really appears to be diseased, which it is not the work of a moment to do effectually; but the removal of the cartilage of the glenoid cavity of the scapula, so as to leave a rough bony surface, to which the inside of the deltoid may adhere, cannot be considered but as an unnecessary addition to the operation, and to the misery of the unfortunate patient.

To saw off a portion of the acromion, it is necessary to detach that part of the deltoid muscle arising from it, and the flaps so formed cannot be supposed likely to take on healthy adhesive action with the bone beneath; if, however, the operator should have inadvertently laid bare the process to any extent by his first incisions, so as to make it come through by the subsequent retraction of the skin, or any accident should render it advisable to remove a part of this bone, it may be done without any other consequence than the inconvenience of doing it, and the greater deformity it occasions in the appearance of the patient. Boucher, in the second volume of the Memoirs of the Royal Academy of Surgery, in France,

mentions in his second part, that M. Le Faure, an assistant-surgeon in the French army, after the battle of Fontenoy, performed this operation, removing a part of the acromion in consequence of its having been injured by the ball, and that it subsequently exfoliated, the patient, an English volunteer, ultimately getting well; and it has been several times done lately in the Peninsula, without any bad effect.

With regard to the coracoid process, it appears to me perfectly distinct from the operation; indeed, I consider the integrity of this part as essential to its success; forming a barrier on one side for the protection of the artery and the fore part of the chest, by the firmness of the parts arising from, and situated in its neighbourhood; and by their remaining in their natural situation, preventing the formation of abscesses and sinuses towards the thorax, which must otherwise inevitably occur in all unfavourable cases. The artery on its division sinks into sound parts, is well supported in all its extent, and placed in the exact situation of a vessel on the face of a stump; whereas, if the upper part of the coracoid process be sawed off, the muscles attached to it must, I conceive, be set at liberty; the short head of the biceps flexor cubiti, and the coraco-brachialis muscle, are cut from their origin, and the pectoralis minor from its insertion into the inner side of the process; and to this, I think, there are serious objections; for the retraction of this muscle is great, and the hollow left by sawing off the coracoid process and the origins of the short head of the biceps and coraco-brachialis, leaves a channel under the pectoralis major and minor to the chest, through all the soft, cellular, fatty substance surrounding the vessels and nerves, which are thus laid open to the external wound, when they would otherwise have been safe, and free from danger.

Too much importance is attached to the idea of even surfaces, and their speedy union being necessary to the success of this, or any other amputation; it will not be denied that they expedite it, but that they can be dispensed with, the following fact will show. On receiving the returns, and examining the

French wounded on the surrender of the town of Olivença, in April 1811, the French surgeon-in-charge pointed out a man, whose arm had been taken out so completely, by a cannon-shot, at the shoulder-joint, at the siege of Badajoz, under Marshal Soult, that it was only necessary to cut off the ragged edges of the integuments, and secure the artery. Under the French method of dressing large wounds, by stuffing them with charpie, good granulations formed; and when I saw him three months after the accident, the glenoid cavity was quite shut in, and a surface not so large as the hand, covered with healthy granulations, remained only to be cicatrized to complete the cure, the man's general health being good, and the discharge puriform. In this case, there was not even the aid of muscular parts to fill up the inequalities, or cover the glenoid cavity; but every thing had been done under the greatest disadvantages, by the shooting out and approximating of the granulations.

The operation recommended by La Faye, with the improvement of lengthening the flap to near the insertion of the deltoid muscle, has been and is generally adopted by our military surgeons, and makes a semicircular wound of moderate extent that heals soundly, as far as I have seen, where the parts have been originally healthy. It is objected to this large flap of the deltoid, that it does not readily unite with the parts on which it is laid down, that sinuses form underneath it that are eventually very troublesome; this may occur, but the most important objection is much overlooked, namely, that when in a gun-shot wound this flap can be formed, the operation may frequently be dispensed with, the simple flap operation being performed in its place, leaving an inch and a half or two inches of bone in the articulation. I allude particularly to the flap made of nearly the whole extent of the deltoid muscle, because I know cases will occur in which the flaps cannot be made with advantage from the sides, when they can be saved from above and below; but then the deltoid muscle and the integuments also are torn, and this, in the cases re-

quiring amputation, is so frequent an occurrence, that in proposing an operation on this principle I would, as a general rule, advise one partly after La Faye's method, recommending in some measure Garengeot's under-flap, which La Faye appears to have adopted in part, without being aware of it; for, in cutting the integuments the length he did below the ligature upon the vessels, he allowed for their great retraction at this part, and thereby gained, unknowingly, something tantamount to a flap; for, if the integuments be cut across close to the axilla, it must be a very large flap of the deltoid that will meet them below, and on this supposition it is advisable to gain something on all sides. In the flap operation, formed by the integuments and deltoid muscle, as commonly recommended, the catlin may be thrust through the integuments and under the deltoid muscle to form the flap, or the first incision may be made through the skin and integuments, to allow them to retract, commencing an inch above the posterior fold of the armpit, and carrying it round in a curved form to the same height on the anterior fold; the lower part of the incision being five fingers' breadth from the point of the acromion, the posterior end or point of it being something higher than the anterior one. The deltoid muscle should be cut through close to the retracted skin, the edge of the knife slanting upwards to avoid the whole thickness of the muscle at the lower part; the flap thus formed is to be turned up over the acromion, so as to show the head of the bone in the capsular ligament; the tendon of the pectoralis major is to be cut through on the fore part close to its insertion, the infraspinatus and teres minor on the upper and outside near to their insertions. The capsular ligament being opened into, the incision should then be carried over the head of the bone, which is to be drawn from the glenoid cavity, the whole of the capsular ligament divided, and with it the subscapularis muscle. The bone being separated from the glenoid cavity ought to be detached as low down as will allow the amputating knife at one sweep to cut through the remaining muscles,

nerves, and vessels, thereby removing the arm from the body; and as the integuments on the under part always retract considerably, it is advisable to cut as low down as circumstances will permit at that part, to allow for this retraction. The vessels being secured as before, the flap is to be laid down in apposition with the lower edge of the integuments, and secured by one or more sutures, as may be judged proper; two are generally sufficient at each end of the flap; a good compress and bandage must be retained upon the flaps, and care taken that no collections form round the glenoid cavity, by keeping the flap perfectly in approximation with it, and a direct opening for any matter that may form, which should be daily evacuated; indeed, in these cases, the last part to cicatrize is generally a small opening, from which a little matter may be pressed out.

It will frequently occur that only three fingers' breadth of the deltoid muscle and integuments shall be left entire, which will not be sufficient to cover the wound, unless something be saved elsewhere; this in general may be done on the under part of the arm, when the upper is destroyed, or perhaps from the outside. In these circumstances the upper flap should be left square, or with a little rounding on the outer corner, the operation should be continued as in the last instance, until the head of the bone be removed from the articulation, when, instead of detaching just enough to allow the arm or stump to be separated by one sweep of the knife, the shattered bone should be dissected out, and so much flap then left on the under part, as will meet the upper one when turned up towards it: the bone is taken out without any fear of wounding the artery above where it is divided, if the surgeon keeps the edge of the knife constantly turned towards it. This flap must of course be kept up to the other by three sutures; it retracts but little after they come away, and much facilitates the cure, as I had an opportunity of showing in the case of a German artilleryman after the battle of Salamanca. In fact, with due knowledge of the anatomy of the shoulder-

joint, there can be no difficulty in performing the operation under any circumstances. If integuments cannot be saved from one point, they can from another, or from two or three different places, and be made to meet in apposition afterwards; or if none can be procured anywhere, the artery must be secured fairly on the face of the wound, a slight compress laid on its course to give support, the wound dressed slightly, and the rising inflammation prevented or allayed by cold applications.

The Baron Larrey, who, from his numerous opportunities after the many great battles fought by the French armies, and from his predilection for the operation, has performed it perhaps oftener than any man, declares his conviction of its safety, without fear of subsequent injury, and without scraping or cutting away the cartilage of the glenoid cavity. In sixteen cases that occurred in Egypt he lost but two: of fourteen subsequent to the battles of Wagram and Essling twelve recovered, and one of the remaining two destroyed himself; and in the late campaigns, and under other circumstances, he invariably met with the same success. In several of these cases the scapula was injured by the ball, in others the clavicle and scapula. From amongst them I have selected the two following, one of primary, the other of secondary operation, although not following a gun-shot wound, and for which reason it may, perhaps, be equally acceptable.

"During the battle of Wagram*, the General of Artillery, Daboville, was brought to the Field Hospital, at a short distance from the spot where he was wounded; a cannon-shot having struck him on the fleshy part of the top of the right shoulder, destroying the articulation of the humerus with the scapula, and tearing away a considerable part of the pectoralis major, deltoides, and latissimus dorsi muscles, breaking off the acromion, and fracturing the scapular extremity of the clavicle. The head of the humerus was broken

* Page 353, tome iii.

into three portions, and driven inwards towards the axilla, and one of these had torn some of the meshes of the axillary plexus of nerves. The axillary artery was near bursting, from the almost aneurismal distention of its coats. The pulse was scarcely perceptible, the countenance deathlike, the eyes dull and watery, the voice hardly distinguishable; hiccup, and other convulsive movements denoting approaching death, had supervened, and I doubted for a moment whether he could survive the operation. The delay of a few minutes more would have been fatal, and I performed it less with the hope of success than with the idea of giving him some ease, from the horrible torment he was suffering. The amputation, which was completed in a few minutes, to my great surprise, gave considerable relief; it had been, however, necessary to cut through a part of the pectoralis major, to tie the artery above the injury it had received; and the first success of the operation still left me little or no hope. I had placed him on a straw paillasse, or rather, a bed of dung and dirt, on which he remained in the greatest state of quietude until his removal to Vienna, whither he was carried on a litter prepared for the purpose, the several faintings he had had in this period rendering it doubtful if he could bear the removal, which was consequently delayed as long as possible. The external dressings were changed, but the whole were not removed until the fifth day. The wound was enormous and frightful, the patient was however calm and collected, his voice was stronger, and he had even slept some hours of the first and second night. The dressings were simple and methodical, the General gained strength by degrees, the wound daily improved, and in three months he was perfectly well." This case is a good instance of that degree of nervous commotion attended by pain that is only relieved by the operation.

"Henry Schup*, aged 22, by birth a Dutchman, of the corps of Lancers of the Imperial Guard, was sent to the

* Tome troisieme, p. 370.

fever-ward of the hospital the 7th of June 1811, on account of some scrofulous pains which he had felt for some time in his right arm, combined with a severe pulmonic affection. The remedies otherwise properly advised by the physicians had not prevented the progress of the disease; he had constant cough and expectoration of pus, hectic fever and clammy sweats every night, with little sleep, and could hardly bear on his stomach his bouillé and rice-milk. Suddenly a large abscess appeared above the right elbow, and although the physician considered it critical, he sent him to the surgical wards for treatment. The abscess being large, and the fluctuation manifest, I opened it immediately, the soldier himself, although in the greatest state of emaciation, also requesting it. The first incision gave vent to a quart of fetid matter of a bluish grey colour, mixed with coagula of blood. Several counter-openings were made, through which I passed some strips of linen thread, and after covering them with lint, I surrounded the arm with compresess, dipped in very hot camphorated wine. The patient, whose strength was nearly exhausted by the continuance of his disease, fainted under these operations, and was with some difficulty recovered. He took some claret, with sugar and æther, shortly after, and I ordered for him an antiseptic and cordial mixture to be taken in small quantities frequently night and day, some strong beef-tea, and some good wine. He was relieved, and passed the next fifteen days in a more satisfactory manner. The purulent expectoration and exacerbations of fever were diminished, but the cough remained the same; some new formations of matter appeared above the former abscess, which were opened, and a quantity of blackish ichorous matter discharged. The patient was for a short time easier, but the next morning a hæmorrhage occurred, which would have been fatal, if the orderly officer on duty had not been in the ward to suppress it; searching for the artery a quarter of an hour after, I was surprised to find the lower third of the humerus denuded, and conse-

quently in a state of necrosis as far as the elbow-joint, which was also open in several places.

"These circumstances determined me to remove the arm at the shoulder-joint immediately.

"He was taken to the operating room at the time the pupils were assembled for my clinical lecture, but was so faint as to be almost unable to sit in the usual chair for operations; indeed, his situation appeared so alarming, that every one present supposed he would die under my hands. Seeing, however, that he must inevitably perish if something was not done, the hæmorrhage being hardly suppressed by the assistants, I decided on operating without delay. The flaps were formed in a few moments, the axillary artery, which was held up to me with the inner flap, did not lose a drop of blood, and it was conveniently secured, as well as all the smaller vessels. The proper dressings were applied, and the patient slept in the theatre, where he also remained some days. The operation acted upon him like a cordial. I ordered him some wine and good beef-tea, covered him with hot flannels, fomented his belly and chest with very hot camphorated oil of camomile, and directed his medicines to be continued.

"The dissection of the arm showed the ligaments of the elbow destroyed, the ends of the bone carious, with the inferior half of the humerus in a state of necrosis, and a carious spot was perceivable on the head and neck of the bone; the soft parts were putrefied, and one of the collateral arteries was open.

"During the five first days, I had little to hope for, in spite of the ease he felt after the operation; he remained weak, and apparently dying; the discharges from the wound were sanious and black-coloured; the pulse was small and weak, and the usual excretions had nearly ceased. The tonic medicines administered were increased; a strong digestive, sprinkled with camphor and some drops of sulphuric acid, was applied to the wound, and the strictest care and attention were

given to the patient. On the night of the fifth day he had an exacerbation of fever, followed by an unhealthy copious sweat, which appeared a favourable crisis. From this moment, the discharge became plentiful and healthy, the organs of life resumed by degrees the due exercise of their respective functions, a tranquil sleep relieved the patient of his pain, and rendered him easy; and, to our great surprise and gratification, he gradually improved until the 10th of October, when he was discharged the hospital quite well, being seventy-five days after the operation. With the principal disease, or the disorganization of the arm, the symptoms of phthisis, as well as of his general scrofulous habit, entirely disappeared; he had even acquired flesh, and the regular performance of the whole of the natural functions of the body. The longitudinal cicatrix of the stump hardly exceeded the third of an inch in width."

M. Dupuytren has recommended two methods of performing the operation. In the first, the arm is to be raised to a right angle with the body. The operator then standing on the inside, grasps the deltoid in his hand, and raises it, whilst he thrusts through it, with the other, a straight double-edged knife from before backwards, entering the instrument on a level with the top of the coracoid process, and bringing it out diametrically opposite, by passing it close over the head of the humerus. He then carries the knife downwards as far as the insertion of the deltoid muscle, and completes his flap by cutting obliquely outwards, so as to save more skin than muscle; the flap is then to be raised, the arm, strongly depressed, placed in a state of pronation, and suddenly brought to that of supination, by which motion the head of the bone brings a great part of the capsular ligament and the tendons attached to it, which might otherwise prevent the luxation of the arm, under the action of the knife; the operation is then finished by passing the knife behind the head of the bone, and forming the anterior and under flap.

In the second method, the arm being raised to nearly a right

line with the trunk, the heel of the amputating knife is to be applied to the middle part of the extremity of the acromion, and the incision made downwards and backwards for about two inches, when he carries it through the posterior fold of the armpit into the axilla, dividing it at that part where a line passing from the centre of the joint would form an angle of forty degrees with the axis of the shoulder. In this manner the outer flap is formed, of the external half of the deltoid, of a part of the teres major, latissimus dorsi, of the long head of the triceps, and is to be turned up, when the posterior and external part of the articulation is brought into view, the capsular ligaments and tendons attached to it divided, and the head of the bone dislocated, by bringing the arm forward on the chest; the knife is then to be passed behind the head of the humerus, and the inner flap formed by separating the arm from the body as before. The left hand is to be used for the right shoulder, and vice versâ.

Messrs. Lisfrance and Champesme, of Paris, have recommended the following methods.

"First, The patient is to be placed on the edge of his bed, or upon a chair, the head leaning against the breast of an assistant, the arm approximated to the trunk, and retained in a state of half-pronation, whilst the upper extremity of the humerus is thereby carried outwards and upwards. A small triangular space, slightly depressed, will now be perceived on the inside of the fulness of the shoulder; this space is bounded above by the scapular extremity of the clavicle, and a very small part of the acromion; on the inside by the coracoid process, and on the outside by the head of the humerus. If a straight knife be plunged in at this spot, and made to pass out directly opposite, the upper part of the joint, with the capsular ligament, will be cut into; and by sliding the knife over the head of the bone, the flap may be formed; or the surgeon, placing himself on the inside of the shoulder to be operated upon, ascertains the situation of the bony parts composing the shoulder; then taking the knife in the right hand

for the right shoulder, and in the left hand for the left shoulder, he places the point of this instrument in the triangular space, near where the posterior part of the upper edge of the coracoid process approaches to join the glenoid cavity. He will take care that the blade of the instrument forms an angle of forty-five degrees with the axis of the shoulder, so that of the two edges the upper one is a little turned forwards, the lower, on the contrary, slightly backwards. The knife is then to be pushed through, in a line running from that point of the coracoid process above mentioned, below the acromion, to about half an inch below the place where the posterior part of this process bends back from its horizontal line, taking by this means a direction from above downwards, and from before backwards. The deltoid is to be grasped and raised, when, cutting from behind forwards and a little upwards, the operator slides the knife over the spherical head of the bone, gradually bringing the cutting edge of the instrument into a horizontal position. Whilst this is doing, and the surgeon has made about one inch of the flap, the arm is to be raised a little from the side to about an angle of sixteen or twenty degrees, when the flap will be readily completed, in the manner recommended by M. Dupuytren. In this, the first step of the operation, the flap is at once made, the upper part of the capsular ligament, the tendons of the supra-spinatus, and of the long head of the biceps, are entirely divided, and the tendons of the infra-spinatus and subscapularis are also cut through in part, if not entirely.

"In the second step of the operation, the surgeon passes the knife behind the head of the humerus, which is very easily done in consequence of the separation of the head of the bone from the glenoid cavity, from the division of the tendons inserted into it, and the inner and anterior flap is then formed in the usual manner. The arteries are to be immediately secured. The assistant, compressing the artery, should stand towards the opposite side to that operated upon, and the operator may, if he pleases, stand on the outside of the patient,

and commence the operation by passing the knife from the under part upwards.

"The upper and posterior flap is formed by nearly the whole of the deltoid; the under and anterior or inner flap contains a very small portion of the deltoid, the pectoralis major, latissimus dorsi, teres major, a part of the triceps, the coracobrachialis, the vessels and nerves. The second flap is nearly of the same size in every respect as the first.

"We recommend a two-edged knife for the greater convenience of opening into the joint; and as there is generally from three to four inches in thickness of the soft parts surrounding it, the blade should be six or seven inches long; for if it were shorter it would be difficult to make the upper and outer flap, and if it were longer, it would be inconvenient in making the inner and anterior one. It should be six lines in width; for it might, if narrower, pass between the acromion and the tendons surrounding the joint, without opening into it; if broader, it would be impossible to introduce it between the head of the humerus and the inferior edge of the acromion, which are about six lines apart.

"We have said that the knife should be entered in such manner, that the flat part of the blade may make an angle of forty-five degrees with the axis of the shoulder, and this direction is necessary; for,

"1. If the blade of the knife was parallel to the axis of the limb, the capsule might not be opened. It is true, the condensed cellular membrane, uniting the capsular ligament to the acromion process, would be divided, and the operation might be done after our method, but with less facility.

"2. If the edge of the knife was so placed that the blade would be perpendicular to the axis of the joint, it is plain, that the capsular ligament, the supra-spinatus, a great part of the infra-spinatus and of the subscapularis, would be divided: but to bring the knife into the proper direction to make the upper and posterior flap, it would be necessary to

turn it so much, as to form two incisions nearly at right angles.

"3. In introducing the instrument, the superior edge should not be turned backwards, since the incision is to be made forwards.

"The position we have recommended, therefore, for the knife is the best.

"When the instrument is first plunged into the shoulder, the elbow should be brought close to the body, by which the head of the humerus is carried outwards and upwards.

"1. If the arm was raised from the side, the head of the humerus sliding in the glenoid cavity would pass downwards towards the armpit, and the great tuberosity would be brought nearer to the acromion, from which it will be seen, that under these circumstances a small part only of the capsular ligament would be divided. Moreover, if the arm was entirely raised from the side, it would be impossible to pass the knife through the joint, as it would strike against the great tuberosity of the humerus, unless it were directed between that part of the acromion and the species of neck that sustains the glenoid cavity; but then, besides the probability of not opening into the capsular ligament, the knife would pass, but with difficulty, between the acromion and the great tuberosity of the humerus, as they would be nearly in contact.

"2. If the arm was brought forwards over the chest, the tendon only of the subscapsularis would be cut through, with the supra-spinatus, whilst that of the infra-spinatus would not be touched; the head of the bone would sink less from the glenoid cavity, and the inner and anterior flap would be made with more difficulty. The skin would also fall into wrinkles and be unequally cut.

"3. The same disadvantage would take place in carrying the arm backwards; the tendons of the supra and infra-spinatus would be alone divided.

"If the shoulder should be swelled from emphysema, œdema, or other causes, an operation can still be done, for a

steady compression with the finger will readily point out the head of the humerus and the base of the coracoid process. If this method should even fail to distinguish the exact spot, the situation of the clavicle should be ascertained, and the knife plunged in about six lines distance from its humeral extremity.

"A great advantage in this method of proceeding is, that the operation is easily performed; 1. When there is fracture of the neck of the bone; 2. When there is but a very short stump; 3. When the motion of the arm is nearly or totally lost. Under which circumstances, the rotation of the arm necessary for cutting the tendons on the head of the bone cannot take place according to the directions usually given on the subject."

They add, that it is done in much less time than by any other method. They give, however, another as follows.

"The lower part of the arm being brought forward over the epigastric region, opposite the xiphoid cartilage, and retained in a state of pronation, the operator ascertains the situation, form, and extent of the acromion, and surrounds it in a manner with the fingers of one hand, whilst he commences the operation with the other, applying the heel of the knife immediately below the internal angle of the acromion, and making an incision the width of this process to its external or posterior angle. The arm is then to be rapidly raised from the trunk to about an angle of fifteen or twenty degrees, and at the same time carried a little outwards, whilst the incision is prolonged to the posterior fold of the armpit, which is divided at the point where a line would pass, running from the centre of the articulation at an angle of forty-five degrees with the axis of the shoulder.

"In this first step of operation, the knife, which has penetrated to the bone, has divided the tendon of the supra-spinatus, the infra-spinatus, the long head of the biceps, which will allow the knife to pass behind the head of the bone, although the teres minor should not be divided; but the di-

vision of this muscle must have taken place; for, from the position which we have given to the humerus, the incision passes beyond the lower edge of the great tuberosity, to which this muscle is attached.

"In the second step of the operation, the head of the bone is dislocated, by bringing the arm into the situation on the breast in which it was first placed, and the tendon of the subscapularis, as yet undivided, does not prevent that occurrence. The head of the bone projects backwards, and the anterior flap is readily formed as in other operations; but it will, however, be something larger."

The Baron Larrey, in the fourth volume of his work, has described another method of operating, see Plate IV. He says, page 427, "The patient being seated at a convenient height, I begin the operation by making a longitudinal incision from the edge of the acromion to about an inch below the level of the neck of the humerus, by which I divide the integuments and the deltoid muscle into two equal parts. I then direct an assistant to draw up the skin towards the shoulder, whilst I make the anterior and posterior flaps with two strokes of the knife, obliquely from within outwards and downwards, so that the tendons of the pectoralis major and latissimus dorsi may be included by the two incisions. There is no fear of wounding the axillary vessels, because they are out of the way of the point of the instrument. The cellular attachments of each flap are then to be divided; the flaps are to be drawn back by an assistant, who compresses at the same time the two circumflex arteries, and the whole articulation is brought into view. By a third incision, carried over the head of the humerus, the capsular and articular tendons are divided; the head of the bone is to be drawn a little outwards, and the knife passed behind it to complete the division of the tendinous and ligamentous attachments on that side. The assistant at this moment grasps the brachial plexus with the fingers of both hands, so as to compress the artery and prevent the flow of blood, and the surgeon turning the cutting

edge of the knife backwards, divides the vessels on a level with the inferior angles of the flaps, but a little before the fingers of the assistant. The patient by this method does not lose a drop of blood, and without taking off the compression the artery may be readily found and secured. The circumflex arteries may be then tied, and the bandages applied."

Of the comparative success of the operation of amputation at the shoulder-joint, I can speak most favourably. I consider it to be less dangerous than amputation of the thigh. It has been hitherto supposed that five out of six recover; but this mode of judging is not perfectly fair, for, if in thirty cases three or four fatal ones, that were performed under unfavourable circumstances, be added to the general average, it will be perhaps less successful; but my opinion is, that if all were fair cases, the success would be infinitely greater. In my own practice, and under my own immediate observation, it has been one-sixth; but the relation of the fatal cases will diminish the proportion considerably, and leave it rather one-twelfth; for the third case related is the only one that can fairly be attributed to the operation. I have performed it altogether fourteen times, once only in consequence of a wound from a musket-ball, and that several months after the injury had been sustained. The other thirteen cases were in consequence of wounds from cannon-shot.

John Henderson, of the Royal Artillery, was struck on the 18th of January, 1812, at ten o'clock in the morning, by a shell, in the batteries at the siege of Ciudad Rodrigo, which grazed his right side over the false ribs, and shattered his arm above the lower edge of the pectoral muscle, leaving it a wreck.

The constitutional injury appeared greater after the lapse of two hours than is usual, he did not suffer much pain, but was unequal to bear any operation during the day. Some cordials being given in the night he became more composed, took some tea in the morning, did not complain of severe pain, but referred the greater part of what he suffered to the

side, which was not apparently much bruised; he breathed with little difficulty, and was anxious to be relieved from the weight of his arm. Placed in an erect position on a field-pannier, with the remains of the arm extended, the subclavian artery was compressed above and below the clavicle with the padded handle of the screw tourniquet, by Dr. Armstrong, now of Mount Rath, Queen's County, Ireland. The cuticular incisions were made, the muscles next in order divided, and the head of the bone turned out; no vessels spouted, the assistants carefully attending to their compression, the last separating incision was made, and the arm was removed without the slightest jet of blood. I allowed the compression above and below to be raised in turn, purposely to show its effects, and they both succeeded equally well. I then tied the vessel with a three-threaded ligature. All pressure on the subclavian artery being taken off, the anterior and posterior circumflex arteries showed themselves, and were tied. The pulsation of the axillary artery being very evident, and no hæmorrhage appearing after a little delay, the parts were brought together without force, leaving only a single line of incision. The patient did not say a word during the operation, which lasted but a few minutes, and was exceedingly thankful for its performance when finished. He was put on his blanket and mat, and appeared to have suffered but little.

Ciudad Rodrigo being stormed that night, I did not see him until the next morning, when he was evidently beyond hope of recovery from the injury sustained on his side: he died at night. I sent his body five leagues for the convenience of inspection, and found that the false ribs had given way to the stroke of the ball without being damaged, but it had ruptured the lower edge of the right lobe of the liver, from whence a gradual hæmorrhage must have taken place, a considerable quantity of blood having insinuated itself under the peritonæum, round the fat of the kidney, and into the cavity of the abdomen, which was the cause of his death.

The lungs were sound, adhering on the right side by old

adhesions to the pleura costalis. This operation was exactly what it ought to be, either regarding the mode of conducting it, or the time required for its performance; no vessel of sufficient size to attract observation appeared, until the circumflex arteries were allowed to bleed, the arm being removed; during the whole operation, the man did not lose six ounces of blood, indeed there were not two table-spoonfuls on the floor. The shoulder and adjacent parts being dissected, a quantity of blood from the axillary vein appeared to have gravitated in the cellular membrane surrounding it, as far as its passage under the clavicle; the pectoral muscle had retracted, folding or turning in the lower and inner part of the skin covering it. The axillary artery was divided about an inch below where it gave off the subscapularis; the anterior and posterior circumflex arteries were from one half to three quarters of an inch long; the three ligatures were found clean and firm on the arteries without any intervening substance; and the muscles were divided in such manner as to have afforded the speediest union, if the injury of the liver had not carried off the patient.

Manoel José Gonsalvez, of the Portuguese Artillery, at mid-day, on the 18th of January, 1812, had his left arm shattered by a shell, leaving just sufficient room to place a tourniquet in the axilla, but which was of no use, as the brachial artery hung out nearly three inches beyond the wound, pulsating strongly between my fingers, its end being slightly covered by a little coagulated blood, just sufficient to show the mouth of the artery much contracted. The bone being destroyed to nearly the head of the humerus, without injury to the integuments concerned in the double flap operation, I performed it in the usual manner; four vessels were tied after the removal of the bone, the patient losing upon the whole about half a pint of blood. This man not being of a healthy constitution, the incisions did not unite; on the contrary, they separated, and a tendency to sloughing was observable in the wound.

On the 7th of February, the ligatures were all away, the

wound open, the artery pulsating strongly at the bottom; and erysipelatous inflammation that had appeared for the last day or two was gradually increasing, matter formed under and in the course of the pectoral muscles, and a small slough being taken away on the 14th, a considerable quantity of pus was discharged. The patient was supported by wine, bark, &c. and the most nourishing diet; but the integuments over the clavicular portion of the pectoralis major sloughed, leaving it as clean as if dissected, and the acromion process came through the wound. On the 24th, the wound was quite clean and granulating, but discharging greatly; his health very much reduced. In this state, on the 4th of March, on the troops breaking up for the campaign, he was sent into the Portuguese hospital, at Almeida, and I am uncertain whether he ultimately recovered.

A Russian, a private in the Chasseurs Britanniques, had his right arm carried away by a cannon-shot at the battle of Salamanca, the head of the bone only being left in the socket, the integuments, particularly towards the axilla, being very much destroyed. The operation was proposed to him as soon as I saw him on the 23d of July, but he would not submit to it until such time as he should be in an hospital, although he saw several British soldiers suffer amputation who were lying with him. On the evening of the 24th, he was got into hospital at Salamanca, and as early as possible on the morning of the 25th the operation was performed. He was an elderly man, and had suffered much from the heat and privations he had endured during the three days he had kept this arm hanging by the integuments, but recovered a good deal on the first day after the operation, ate, and said he was better; on the fourth he died from exhaustion, more than from any complaint, the wound looking extremely well. If great care after the operation could have been paid to this man, or if he had suffered his arm to have been removed on the 23d, his life would have been saved. Being a foreigner in our service, I did not choose to insist upon his submitting to the

operation, although I could then have sent him into town with little inconvenience.

I do not conceive either of these three cases can justly be considered as fair ones, or be calculated upon in estimating the comparative success of this operation; death being unavoidable in the first; having been rendered probable in the second, by a succession of circumstances that would most likely have occurred in any other amputation; and in the third it was much to be feared from the delay in performing it, and the age and appearance of the patient; indeed, if the calculation of success influenced an operation beyond a certain point, this poor man would have been left to die untouched, and deprived of that chance, which, under happier circumstances, would have had (I am much inclined to think) a more favourable result.

In the eleven successful cases, three only have any thing deserving of remark: in one, a soldier of the 74th regiment, at the siege of Ciudad Rodrigo, on whom the operation was performed at midnight, the axillary artery was not in the least compressed at the instant of its division, and filled my eyes with blood, when a general expression of alarm burst from all present. At this moment of affright, one of my assistants, Mr. Mahoney, now surgeon of the Royal Fusiliers, who was previouly prepared if such an accident took place, pressed his closed hand on the vessel until I was ready to secure the artery with my finger and thumb, which was most readily effected. The man did not in all lose twelve ounces of blood, and is now perfectly well in England.

Another is the case of a Frenchman, who was wounded at the battle of Salamanca, by a musket-ball, in the middle of the arm, which broke the bone, and whom I found, after a number of vicissitudes, in Lisbon, in April 1813, suffering from hospital-gangrene, which had spread round the arm nearly into the axilla. Destroying all hope of preserving it, and if retained any longer, rendering his life very precarious from the rapidly sinking state of his health, I deemed it ne-

cessary, from the appearance of the muscles, integuments, and bone, to remove the arm at the shoulder; but though all the muscles on the under part were so much diseased as to destroy the hope of union taking place, yet the success I had met with in amputating in cases of gangrene from defect of circulation, induced me to attempt it here in a case of hospital-gangrene; and which, although depending on very different causes, would, I am convinced, have done well from the first, if the man had been removed into another hospital free from the contagion of this disease. In four days half the integuments had united on the upper part, but the lower was inflamed, painful, and swelled. On the 20th, eight days from the operation, the ligatures were thrown off, the lower part was in a gangrenous state, and the upper part, that had united, entirely separated; but the glenoid cavity was not exposed. On the 1st of May, the whole surface of the stump was in a gangrenous state, and continued so until the 17th, by which time a considerable portion of the muscles on the under part was destroyed; the wound at this period became cleaner, and the disposition to gangrene ceased. On the 24th, as the muscles had commenced granulating in every direction, the integuments were drawn a little together, and pressure made by sticking-plaister and bandage. From this time the wound gradually filled up and contracted, leaving a very small cicatrix, compared with its open surface when in a state of gangrene.

This man was only saved by the attention of three servants, who constantly waited upon him, by the administration of wine and the most generous diet, varied according to his caprice or inclination, and a change to the purest air of Lisbon.

If he had been in an hospital where the means were limited, either in point of accommodation, diet, attention, or medical assistance, he must inevitably have died. The last case has nothing peculiar in it, save that the patient at the same time lost the right fore-arm.

I have not included in my calculation of success very many cases that have come under my observation, in which the arm, scapula, &c. (with more or less injury of the adjacent parts) have been carried away by cannon-shot or shells, which have been nearly all fatal; but as the operation was not performed, except in the removal of fragments, it cannot of course be considered as affecting the surgical operation of amputation. In such cases, all broken pieces of bone are to be taken away as speedily as possible, the jagged, rough, and destroyed parts removed, the smaller arteries opened by these operations secured, and the principal vessels searched for and tied, if they can be found by fair examination, without hazarding the life of the patient by unnecessary and tedious search. If the axillary artery be found injured, it must be followed up, if necessary, to the clavicle, by cutting through the pectoralis major from the wound, and tying the vessel in the hollow between the pectoralis minor and the bone.

In giving an account of the success of some of my contemporaries in the campaigns in the Peninsula, I must premise, that the operation had become much more common among military surgeons than formerly; whether it was that its own utility rendered it necessary, or that our surgeons were better operators, or that it has been occasionally performed without due discrimination, I cannot determine. Perhaps a combination of the whole of these circumstances may have been the cause of its multiplication; the latter I am desirous of believing to have little increased the number.

The following returns of the operation, as performed in the army under the Duke of Wellington, during a period of six months, from the 21st June to the 24th December 1814, may not perhaps be uninstructive. It includes the wounded at the battle of Vittoria, the destructive siege of St. Sebastian, and the battles of Pampeluna and the Pyrenees, and is another remarkable illustration of the necessity of operating on the field of battle, in preference to the delay of

a secondary operation; the operations with the divisions of the army having been all primary, at the general hospitals, secondary.

General Hospitals.	Number of Operations performed.	Died.	Cured, or out of Danger.
Vittoria	13	10	3
Bilboa	5	5	0
Passages	1	0	1
Total	19	15	4

Divisions of the Army.	Number of Operations performed.	Died.	Cured.	Transferred, but considered out of Danger.
1st	3	0	2	1
2d	1	0	1	0
3d	1	0	1	0
5th	12	0	12	0
6th	1	1	0	0
Light	1	0	0	1
Total	19	1	16	2

The 5th division performed the duties of the siege of St. Sebastian, and the men were principally wounded in the upper part of the body. The operations were all performed under the direction of Mr. Gunning, the surgeon-in-chief, whose report is now before me, and is quite conclusive on all the points I have wished to inculcate.

The loss with the divisions of the army was as one in nineteen in favour of the primary operation; a success truly

astonishing. In the General Hospitals, under surgeons equally able, the loss was fifteen in nineteen; a want of success as disheartening, as the reverse in the other is encouraging; and arising from all the causes mentioned in the remarks on "Amputation," as concurring in the ill success of secondary operations.

Bromfield* states, that before his time the operation had been performed in the British armies, but unsuccessfully, which I believe was frequently the case when formerly attempted. It is now, however, the reverse, is in general successful, and performed by military surgeons without hesitation or fear; and I trust I have proved, that this once formidable operation may now be considered as safe, as simple, and as little hazardous, as any other of importance performed on the human body.

Excision of the Head of the Humerus.

Having treated of wounds requiring amputation at the shoulder-joint, the operation of sawing off, or removing the head of the humerus, when alone injured, next deserves the particular attention of the military surgeon. It has been recommended as a substitute in many cases for amputation, by which means the limited use of the fore-arm is preserved; and there can be no doubt but it may supersede it in others, for cases of gun-shot wounds do certainly occur, in which this operation may be practised with success, where the removal of the arm would appear a severe measure.

This operation of removing the head of the humerus was first noticed by Boucher, in his paper inserted in the Memoirs of the Royal Academy of Surgery in France, and practised nearly about the same time by M. Thomas, a surgeon at Pezenas in Languedoc; that of sawing off the head of the bone was first recorded by Mr. White of Manchester, in 1769,

* Page 209 of his Chirurgical Observations and Cases.

who performed the operation in 1768: it also appears, that M. Vigarous, senior, of Montpellier, did it in the year 1767, on a lad of seventeen years of age, who died a very short time after; but as he did not make this operation publicly known until the year 1788*, the credit of its introduction indisputably belongs to Mr. White. It was subsequently recommended by Mr. Park of Liverpool, in 1783 and 1789, and about the same time in France by Moreau, father and son; and shortly afterwards by Sabatier, Percy, Larrey, and other of the French surgeons. It was first recommended in cases of caries of the joints in domestic surgery, but has not, I believe, been much practised either in France or England, and particularly in the latter, where it met with much opposition; and it has not prevailed in the British army, although in the French it has met with considerable support from Messrs. Percy and Larrey. The inattention paid to it by the medical department of the British army, arose not from any experience of its failure, but possibly from too great an attachment to the operation of amputation, in consequence of its success, and from magnifying the dangers attendant on the other; for it is more than probable that some fair cases, in which the sawing off the head of the bone might have been tried, have offered themselves in the course of the late campaigns, and have been disregarded. The instances I shall presently adduce prove, however, that it was not the practice of the surgeons of the British army to amputate unless the joint was *materially* injured. The first and one of the most successful cases of the removal of the head of the humerus that have occurred is the following.

M. Thomas, surgeon at Pezenas, in Languedoc, was desired, in the month of August 1740, to see the daughter of a labourer, four years of age, who was suffering with a very acute pain in her left arm, from which she had no respite, and which was dreadfully increased whenever the arm was touched;

* Œuvres de Chirurgie Pratique, par I. M. I. Vigarous, junior. Montpellier, 1812.

it was first felt after the confluent small-pox, which she had had two months before; the pustules of which had not properly maturated, and the child since that had suffered from a low fever. He carefully examined the arm, and found it considerably swelled about the joint of the shoulder, without any discoloration of the skin, and concluded that a large abscess was forming in the joint itself, which might prove fatal to the little patient. The first indication was to assuage the violence of the pain, and for this purpose an opiate was given proportionate to her age; an anodyne poultice was applied to the tumour, and afterwards varied according to circumstances. Under these applications the abscess broke spontaneously at the anterior and upper part of the arm, four fingers' breadth below the acromion, and discharged a very great quantity of purulent and glairy matter; the tumour diminished in size, and through the opening a very irregular portion of the bone could be distinguished.

This opening being considered too small, M. Thomas enlarged it by an incision upwards towards the acromion, and downwards towards the insertion of the deltoid. The wound was dressed with dry lint, an appropriate bandage applied, and the limb placed in a proper position. At the second dressing he was not a little surprised to see coming out of the wound about an inch and a half of the humerus denuded of its periosteum, and which appeared to have separated from the head of the bone, which he supposed to have remained in the glenoid cavity.

The disease was treated as a fracture, and the greatest attention paid by compress and bandage to keep the bone in its place, but in vain, as it constantly protruded through the wound. M. Venel, senior, was now consulted, and after an attentive examination, they agreed in thinking that the cure of the disease should be left to nature, and that they should confine their endeavours to assisting the exfoliation of the exposed bone by the proper remedies. Thirty days afterwards, the extremity of the bone was felt to vacillate, and the next

morning, M. Thomas extracted a portion of the cylindrical part of the upper extremity of the humerus, of about an inch and a half in length. The day after he brought away the epiphysis forming the head of the bone. After the removal of this piece the wound healed, and six weeks afterwards, the bone which was taken away was completely replaced by a new formation, and the health of the child entirely re-established.

The child recovered the perfect use of the arm, which was of the same strength, length, and appearance, in every respect as the other, and at fifteen years of age was able to do the household work of a whole family. She was afterwards drowned, but M. Thomas was not able to examine the body, to ascertain the nature of the regenerated bone.

Mr. White*, in a case of a caries of the head of the humerus, after an abscess with two openings, one under the acromion process, sawed off the head of the bone in the following manner, being the first operation of the kind then on record. "I began my incision at that orifice which was situated just below the processus acromion, and carried it down to the middle of the humerus, by which all the subjacent bone was brought into view. I then took hold of the patient's elbow, and easily forced the upper head of the humerus out of its socket, and brought it so entirely out of the wound, that I readily grasped the whole head in my left hand, and held it there until I had sawn it off with a common amputation saw, having first applied a pasteboard card betwixt the bone and skin."

He adds, that not more than two ounces of blood were lost during the operation. The patient gradually recovered. Two months after the operation he took away another large piece of bone that had been denuded by the matter, and in less than four months he was discharged cured. The bone taken away was alone four inches long; the arm was but one inch shorter, with the perfect use of the joint; and it would

* White's Cases in Surgery, page 57.

appear that a regeneration of bone had actually taken place. These, the first cases on record, are by far the most successful of any hitherto published.

Moreau, junior*, gives the following case from his father's practice.—"On 15th of June, 1786, my father was called to see the wife of M. Vivy, proprietor of the forges at Cousances. She was in her forty-fifth year, and had for ten months been affected with a complaint in the left shoulder-joint; the shoulder and arm were very much swelled; the fore-arm and hand were œdematous. When any attempt was made to move the joint, she felt the most acute pain. Indeed she was in constant uneasiness, had lost her appetite, and got little sleep.

"Some months previously to the time when my father was consulted, M. Balthazard, surgeon in the town, had, on account of an abscess, made a longitudinal incision, about three inches in length, on the foreside of the joint.

"My father, being of opinion that the joint was carious, persuaded the woman to have the diseased parts removed; which he accomplished on the 8th of July in the following manner.

"He made a longitudinal incision on the posterior side of the joint, beginning a few lines below the acromion, from which it extended three inches downwards. This incision was parallel to, and four inches distant from the one which had been formerly made. He laid them into one by a transverse incision, which cut through the flesh about six lines below the upper attachment of the deltoid muscle. Thus a large flap, of about four inches in breadth and three in length, was produced; which, after being detached from the bone, he folded down on the arm.

"He next made two other incisions, one from each end of the transverse incision. The anterior of these pointed towards the outer end of the clavicle, and the posterior towards

* Moreau translated by Jeffray, page 162.

the spine of the scapula. This gave him a new flap, which he raised; and then he had no difficulty in discovering the whole extent of the caries.

"This done, he dislocated the os humeri, and having pushed it up, and ascertained how far down the caries extended, he there sawed the bone across; after which, with the gouge, he rounded the corners of that part of the bone which was left.

"He next lowered the arm, and made it be held close to the side, and then, with ease, he removed, by the gouge, the whole external angle of the scapula, together with a part of the acromion.

"After having taken away as much of the cellular substance, that was filled with hardened lymphatic matter, as he could, he put the patient to bed, and placed the limb in such a position, that the arm formed a right angle with the trunk, the elbow-joint being half bent. He brought the flaps together, fixed them by stitches, and covered the wounds with charpie, which he secured by compresses and the eighteen-tailed bandage.

"During the first day, the patient was in great pain. The following night she got a little sleep. For some days she was feverish. Till the eighth she was kept on a low diet, when she was allowed something more nourishing. On the eleventh she was permitted to rise for a short time; on the fourteenth she did not feel much pain, when the arm was gently moved: the upper wounds were beginning to unite; the anterior and posterior humeral flaps were discharging pus, both good in kind, and abundant in quantity; and the œdema was disappearing. A small quantity of bark was ordered for a few days, and her bowels were regularly kept open. On the twenty-first day the suppuration had nearly subsided, and she could move the arm.

"In the month of October, following, the cure was retarded by a phlegmonous tumour, which appeared sponta-

neously on the middle of the arm. It had no communication with the wound, and in a short time it healed.

" After the cure was completed, a hollowness remained at the top of the shoulder, as in luxations of the humerus downwards. The upper end of the os humeri rests on the ribs, anterior to the external edge of the scapula. In so far as can be perceived, its size is nearly the same ; and it has formed a kind of symphysis with the surrounding parts, in such a way, that the arm can perform all its motions, except that of elevation, which is very much confined."

In the year 1790, the Baron Percy presented to the Academy of Sciences of Paris, a young man, sixteen years of age, who had recovered after this operation ; he also laid before the society a portion of bone which had been extracted fifty-five days before. This person afterwards became an officer, and was killed before Rastadt.

In 1794, M. Percy showed to Sabatier, the Professor of Surgery in Paris, nine other cases in which the removal of the head of the humerus had been successfully performed, and a short time after a medal was granted by the academy of Sciences to M. Fernire, as an honorary reward for a successful operation of the same kind, on a boy of fourteen years of age, whose arm two of the most celebrated surgeons in France at that time, had recommended to be removed at the joint.

Baron Larrey*, on this subject, says, " It sometimes happens, that a ball fired at a short distance shall strike the humerus immediately below its head, and break it short off. The extent of the injury is not immediately perceived; two small openings only are seen, and the shoulder preserves its natural fulness, because the head of the bone has remained untouched, or, if broken in pieces, still is retained in its relative situation to the glenoid cavity of the scapula. There is, however, a mode of discovering the mischief done to the joint;

* Tome ii, page 173, de Chirurgie Militaire.

for if in the first instance the fingers are pressed moderately in the course of the bone between the two wounds, a deep hollow is felt, being the want of continuity of the bone, caused by the retention of the head of the humerus in its capsular ligament to the scapula, and the separation of the body of the bone, which sinks and turns a little inward by its own weight.

" Under these circumstances it would be useless to dilate the entrance and the exit of the ball, as the dilatation cannot be made with propriety sufficiently large to allow the head of the bone to be easily extracted.

" Yet the presence of this body, become a foreign substance, since it has lost its communication and connection with the body of the humerus, causes irritation and inflammation of the joint; abscesses, sinuses, and caries, soon become evident, and there is no resource but in amputation.

" I have had the good fortune, in ten cases, to prevent this unfortunate result, by extracting either the head of the humerus, or its fragments, without delay, and in the following manner:

" I make an incision in the centre of the deltoid muscle parallel to its fibres, carrying it downwards as far as possible, and separating the edges of the wound to show the joint, the capsular ligament of which is generally open; with the curved blunt-pointed bistoury, I readily cut the attachments of the supra-spinatus, infra-spinatus, teres minor, subscapularis, and the long head of the biceps; I then disengage the head of the bone, and turn it out through the incision, by pushing it from below with my fingers, or by any appropriate lever from the lateral wounds; the arm is then to be approximated to the shoulder, and retained in position by a proper bandage and sling. In this way I have extirpated the head of the humerus in ten cases. One of these died of fever, two of scurvy at Alexandria, a fourth of the plague after our return from Syria; the others were sent to France cured; the arm had

anchylosed with the shoulder in some, and in others had formed a sort of artificial joint which allowed of some motion.

"The fractured part of the bone must exfoliate; and to aid nature in her operations, and prevent caries of the medullary cavity of the bone, the incisions must extend as far downwards as the bone has been injured, by which collections of matter or the formation of sinuses will be avoided; the dressings should be frequently, carefully, and gently changed, as the suppuration is generally plentiful, sharp, and ichorous, and irritates and inflames the neighbouring parts; in the first stage emollient fomentations and poultices are useful.

"When the exfoliation is complete, the humerus is to be placed in contact with the glenoid cavity of the scapula, the cartilaginous surface of which is already effaced, and readily forms an anchylosis; but if the exfoliation is slow, this does not take place, and a sort of joint is formed, which diminishes considerably the strength of the limb. After the poultices can be dispensed with, recourse must be had to gentle compress and bandage moistened in edulcorated wine.

"This operation should be performed as soon as possible, as it prevents irritation, inflammation, abscesses, sinuses, and extensive caries of the humerus, that would require amputation of the arm.

"Jean Fischer, grenadier of the 69th demi-brigade, was wounded by a musket-ball at the taking of Alexandria; the ball entered about an inch from the clavicle, near the axilla, passed through a part of the pectoralis major, and coracobrachialis muscles, and fractured the humerus below its tuberosities, with some few splinters of the body of the bone, the head remaining untouched, and retained in its situation by the tendons inserted into the tuberosities; the ball then passed out opposite to its entrance, dividing the circumflex arteries, which bled considerably, and much weakened the patient.

"Having ascertained the nature of the injury, I dilated deeply the entrance and exit of the ball; but not being able

to dislocate the head of the bone in this manner, I made a longitudinal incision in the middle of the deltoid, at the most prominent point of the joint; and raising the shoulder, the edges of the last-mentioned wound being separated as much as possible, I cut with my blunt-pointed bistoury the ligament and tendons surrounding the joint, and turned out the bone through the opening. All the splinters were carefully removed, the arm approximated to the scapula, and in sixty days the cure was complete. The broken end of the humerus exfoliated, and the bone anchylosed with the scapula."

The following case is even more remarkable, from the nature of the wound, and from its fortunate result.

"Jean Gravel, aged 17, a drummer of the 32d demi-brigade, was wounded at the battle of the Pyramids in the act of beating the charge, by a four-pound shot, which, in striking the top of the shoulder, did not carry away the fleshy parts, but merely broke the skin over the point of the acromion process, fracturing underneath the head of the humerus, the scapular end of the clavicle, the acromion and coracoid processes; the deltoid muscle was also very much injured by the impetus of the blow. I entertained a hope of saving this limb in defiance of the extent of injury, the axillary vessels, nerves, and tendons in the axilla remaining sound. I readily took away the displaced portions of the acromion and clavicle, by cutting down upon them; the extraction of the head of the humerus was more difficult, in consequence of its being firmly retained by its attachments in contact with the glenoid cavity of the scapula.

"The young man bore the operation with fortitude, and no untoward accidents occurred in its performance; the first fifteen days were, however, passed in extreme danger. After considerable swelling, with pain, redness of the skin, fever, watchfulness, &c. a plentiful suppuration came on, with advantage to the wound, and general relief to the patient. A part of the humerus, destroyed by the fracture, and afterwards a portion of the spine of the scapula, with the glenoid

cavity, exfoliated. After this the wounds soon cicatrized, the arm anchylosed with the shoulder, by the gradual approximation of the former, and this young man at last was perfectly cured, when he embarked for France with a party of invalids, who were lost at sea, having never more been heard of."

He gives another instance of a wound of the same nature, cured in about the same time, but in which an artificial joint was formed, allowing some slight movement in every direction; and it is remarkable that this man had less strength in his hand and arm, than where the anchylosis had taken place. His other cases differed little from the three preceding, and are not related.

In the British army I have seen several cases of the same kind, which were all unfortunate, except one in a drummer at Salamanca, wounded during the siege of the fort, whilst at play at the gate of the hospital; in which the head of the humerus, scapula, and clavicle, were fractured, and were taken away in part, and the rest exfoliated, but the arm was of little use, and the suffering great and protracted. In these extreme cases, nothing more can be done than to remove the pieces of the different bones which have been injured.

At the successful assault of Badajos, in 1812, Lieutenant Madden, of the 52d light infantry, received a wound on the top of the shoulder, immediately below the acromion process, which penetrated the joint, and lodged in the head of the humerus. My opinion was desired as to the necessity for amputation, or otherwise; and I agreed with the gentlemen in attendance as to the propriety of the removal of the pieces of bone, of having a fair opening after the discharge, and awaiting the result, which has been his having preserved a very serviceable arm.

Robert Masters, of the 40th regiment, was wounded by a musket-ball, on the 12th of April 1814, at the battle of Toulouse, in the right shoulder, at its anterior part, nearly where the cephalic vein passes between the deltoid and pecto-

ral muscles. The ball did not pass out: the head of the bone was observed to be injured, but the ball was not discovered. The man being of a patient, determined disposition, bore it without much complaint; and the surgeon in consequence paid less attention to it than it deserved. It was shown to me a few days after the accident, with other wounds of the joints, as a case that required operation; there was high inflammation, and considerable pain, particularly on the slightest motion, attended with fever, and much uneasiness. I directed venesection, cathartics, leeches, with a constant change of cold and wet applications, and the lowest diet. I considered it a fair case for excision of the head of the humerus, whenever the inflammatory symptoms should have diminished, and requested the man might be constantly under observation for that purpose. Under this treatment for some time, the joint gradually diminished in size, the pain became less, the patient more quiet, and there appeared no immediate necessity for the operation. Six weeks after the accident, the suppuration becoming good, and some small pieces of bone discoverable, an incision was made in the course of the original wound, and the ball, with a large piece of the head of the humerus, containing nearly one-fourth of its articulating surface, and a tolerably thick portion of the cancelli of the bone, were extracted without much inconvenience to the patient. About ten weeks after the accident, the man was walking about in good health, the arm being nearly immoveable and giving little uneasiness, a small sore only remaining. In the beginning of July, three months from the receipt of the injury, the man was sent to Bordeaux on his way to England, free from pain, and with no other inconvenience than the loss of motion in the shoulder, which was perfectly stiff, anchylosis having most probably taken place between the head of the humerus and the glenoid cavity of the scapula, the cartilages having been absorbed or destroyed. This man has of course the use of the fore-arm, and a limited use of the upper arm by moving the shoulder on the trunk.

Private Oxley, of the 23d regiment, was wounded on the 12th of April, at Toulouse, by a musket-ball, which entered on the anterior part of the shoulder and passed out behind, striking the fore part of the head of the humerus on its passage; the deficiency of which was clearly to be perceived on a slight examination. It gave him, however, little pain or uneasiness, and was dressed for some days as a simple flesh wound. It was shown to me with the other wounds near the joints, in the charge of the gentleman who had dressed the slight cases, and the man was subsequently treated as the nature of his wound demanded, in the usual antiphlogistic manner, as I conceived this would also turn out a fair case for removing the head of the bone: no bad symptoms supervened; the man carried his arm in a sling, complained much of the restraint imposed upon him, and the want of food. He never had any bad symptoms. Some few very small pieces of bone came away with the dressings, which were the simplest possible; and in the begining of July he accompanied me to Bordeaux on his way to England, his arm quite healed, and free from pain, but stiff at the shoulder, of which joint he had quite lost the motion. The lower arm he used as before the accident.

These cases may all be considered fortunate. I have seen others in which part of the head of the humerus came away, and the arm has been preserved. I have also seen such cases ultimately terminating in amputation. The only and unsuccessful case of the shoulder-joint, after the battle of Toulouse, was of this nature. These cases establish however the fact, as to the line of practice adopted at the termination of the Peninsular war, beyond the possibility of honourable disputation.

After the battle of Waterloo, we find, on referring to Dr. Thomson's Report of Observations made in the Military Hospitals in Belgium, that the precepts of the Peninsular war, on this point, were not forgotten. He says, page 149, "A variety of cases occurred, in some of which the shoulder-

joint had been struck, and others in which it had been laid open by grape-shot and by cannon-balls. In some of these cases amputation had been performed; in others, attempts were making to cure the injuries without the removal of the limb. In one case, a ball had carried away the integuments on the upper and fore part of the joint, together with the greater part of the deltoid muscle, and had shattered the head of the humerus. The head of the humerus exfoliated, and about seven weeks after the injury, four inches of the upper part of that bone were removed from the socket. Pains were taken to bring the soft parts together by means of adhesive straps. The appearances were favourable beyond what could be expected in an injury so severe. In another case, also, which seemed to promise favourably, the greater part of the deltoid muscle had been removed by a cannon-shot; but the joint itself was not exposed, nor did the head of the humerus appear to have been much contused. Appearances were less promising in a case in which a cannon-ball had carried away the upper part of the left deltoid, and had laid open the joint. In another case, in which the upper part of the deltoid was carried away, the acromion process protruded, and seemed as if it would exfoliate." At page 153 he says, "A few seemed to be in a state of recovery, in whom balls had actually passed through the shoulder-joint; and several in a state which would probably require amputation on the subsidence of the secondary constitutional symptoms by which they were attended. Even in the greater part of these cases, which had the most promising appearance, a great degree of swelling continued to exist, accompanied by extensive suppurations, fungous protrusions from the wounds, and exfoliations of the bones, with their usual constitutional symptoms." At page 154 he says, "In another case, the ball had entered on the anterior part of the shoulder, aud seemed to be lodged in the head of the humerus; and in another a ball had passed through the head of the humerus. In none of these three cases was any great degree of swelling or inflam-

mation produced. In one case, in which a musket-ball had passed through the right shoulder-joint, at the end of the sixth week the wounds had healed, but the joint remained stiff and immoveable." All these cases I saw at the same time as Dr. Thompson, and can give my testimony to the correctness of the remarks.

The following case was communicated to me by Assistant-Surgeon Kennedy, late of the 41st regiment, and acting as surgeon on board the flotilla on Lake Erie in Upper Canada.

"Corporal Matthew Osdale, aged 26, Royal Newfoundland Fencibles, serving as a marine on Lake Erie, Upper Canada, was wounded by a grape-shot in the action with the American squadron, on the 10th Septemper 1813, which entered in front, immediately below the coracoid process of the scapula, broke the humerus to pieces in its course, and came out at the back part of the arm, at the outer edge of the deltoid muscle. A considerable portion of this muscle was lacerated, and the splinters of the bone extended into the joint.

"Having seen the wound a few days after the action, when in a high state of inflammation, it did not occur to me even to doubt of the necessity of amputation, until, on a second inspection, when the dressings were removed, it presented a much more favourable appearance than I had been led to expect.

"The inflammatory symptoms had subsided. The granulations around the edges of the wound were clean and healthy, the discharge, except here and there, where it was streaked with a thin brownish matter, the consequence of exfoliating bones, was of a tolerably good quality, and the health of the patient had much improved during the last ten days. Taking, therefore, these circumstances into consideration, and particularly that this was the right arm of a young man of a sound constitution, I thought myself justified in giving it as my opinion, that immediate amputation was unnecessary, as there was a probability of saving the limb.

"So soon as we arrived at Presqu'l, where we were to re-

main, I had an opportunity of attending more particularly to this case; and on examining the wound, found that a number of splinters had been driven to the back part of it, and lay embedded among the muscles, that several pieces adhered to the ends of the fractured bone and were somewhat loose, and that the pieces extending into the joint included a considerable portion of the head of the humerus, which was scarcely moveable, although it caused a profuse dark-coloured discharge.

"In order to remove the broken pieces of bone, I made a large and deep incision at the back part of the wound, in the direction downwards, from its lower edge, by which I was enabled (although with some difficulty in cutting and tearing them out) to take them away. Previously to this, the irritation from these extraneous bodies had been great, and the suppuration was excessive, a degree of hectic fever had been induced, attended by a diarrhœa which was rather alarming. In a few days after the removal of these pieces of bone, the suppuration was reduced, and the hectic and diarrhœa were removed by small doses of rhubarb and columba, a little wine, and a light generous diet.

"To facilitate the extraction of the pieces which adhered to the ends of the fractured bone, a part of this incision was kept open, and the wound in front enlarged; by which I was enabled to deal freely with them, and in a short time they were all removed; thirteen pieces having been taken away in the course of five weeks.

"There still remained, however, the large splinter, which extended into the joint, causing much irritation, with a profuse gleety discharge from the socket, thereby retarding the general healthy action of the whole. The removal of this piece was a sine quâ non in order to save the arm; but I must confess the result of this gave me not a little concern, particularly as the practice of opening the joint for the purpose of extracting splinters of the head of the bone was new to me; and as I had taken the case entirely on my own responsibility, a failure would have made a very unfavourable impression.

"The operation in itself, however, appeared to have no danger in it, and I had still this consolation remaining, that if it should fail, the last resource was yet in my power.

"I made an incision with a large scalpel, beginning at the upper edge of the wound in front, and carrying it upwards in the direction of the fibres of the deltoid muscle into the joint, by which the capsular ligament was slit up, and the head of the bone exposed, over which the fissure of the fracture was seen to run. I then enlarged the incision downwards from the joint, detached the piece from its adhesions, and increased the opening in the capsule to the extent I thought necessary to allow of the removal of the bone. Having introduced a pair of strong forceps at the under part of the fracture, I made use of it as a wedge, and with a very slight degree of force effected the separation and extraction of the piece of bone, including fully one-third of the head of the humerus. During the incision a small artery bled freely and was secured. The lips of the incision were brought together with adhesive plaister, splints and a bandage were duly applied, and the arm placed in a proper position.

"During the first two days the inflammation ran high, with a considerable degree of pain in the part and corresponding fever.

"On the evening of the third day, the pain and tension had much increased; I therefore removed the splints and dressings, and found that the lips of the wound had receded, and were much swollen, the discharge was in great quantity and of a bad quality: the wound was dressed simply, and a poultice put over the whole. The next morning the pain, tension, and fever had abated; but the discharge was still the same.

"The wound was dressed from the bottom, with lint wetted with a solution of the sulphate of zinc and camphor, and a saline draught was ordered to be taken occasionally.

"On the morning of the fifth day after the operation, the inflammatory symptoms had subsided, the fever was reduced, but the matter from the socket still continued bad. I put

him on the use of bark and wine, with a more generous diet. In the course of a week, on this treatment, the discharge improved, and the granulations began to assume a healthy appearance.

"The extraction of the splinters had left a vacancy of nearly two inches between the fractured ends of the bone, besides that caused by the removal of part of its head, which was to be replaced by callus; and the formation of it was now the object devoutly to be wished for.

"To assist nature in this process, splints were applied to retain the arm in a proper position; compresses were used to prevent the formation of sinuses, and the patient's powers were supported by generous diet, with a continuance of his bark and wine, or rum and water, when no contra-indication required their being dispensed with.

"The chief obstacle in the progress of the cure was the discharge, which for a long time continued profuse, and still threatened to insinuate itself downwards among the muscles, requiring the frequent removal of the splints and the reapplication of the compresses. His health, however, continuing good, those difficulties were surmounted, and in the course of seven weeks after the removal of the whole of the splinters (three months from the time he came under my charge), the consolidation of bone was complete, and I had the satisfaction of throwing off the splints and seeing him use his arm.

"I induced him to move it frequently, and as freely as he could, for the purpose of procuring as much motion of the joint as possible, and this he had obtained to a considerable extent; but in travelling into the interior of the states he was overturned going down a steep hill in a sleigh, and wrenched this shoulder. Inflammation ensued, the wound partly opened, and two or three more pieces of bone came away. Since then, the joint has been anchylosed, but he still retains so much motion, from the range of the scapula, as to enable him to put on and take off his clothes, tie his handkerchief, use his knife and fork, and perform many other operations of comfort and

convenience; which, had amputation been performed, he must have been for ever deprived of."

The American surgeons, about the same time, having read the observations of the Baron Larrey on this subject, profited by them; and we find Mr. Mann, in his Sketches of the Campaigns of 1812, 1813, and 1814, in Upper Canada, page 208, gives the following instances of serious injuries of the shoulder from which the patients recovered.

"At the engagement of Plattsburgh, Lieutenant Duncan, of the Navy, was wounded by a cannon-ball, which passed in the direction of the scapulo-humeral articulation. The superincumbent muscles of the shoulder, with part of the subjacent, were destroyed, leaving a small portion in the axilla, connected with the principal artery, which received no injury. The acromion process and clavicle were fractured; the head of the humerus was broken, and four inches of its substance forced away by the ball, leaving an inch of its extreme head attached to its socket. In similar cases Larrey recommends immediate amputation. From the destruction of the parts, my opinion was, that, to save life, amputation was absolutely necessary. I had previously read Larrey's statement of wounds cured only by the operation, of which he triumphantly says, 'the truly intelligent, bold, and experienced man can alone know and appreciate the effects.' Lieutenant Duncan objected to amputation; saying, he had rather lose his life than his arm, the loss of which he did not wish to survive.

"The fractured pieces of the bones, and ragged portions of the muscles, were removed by the attending surgeons, Doctors Brown and Walker, after he was removed to Burlington, distant twenty-five miles. By attentive and careful attention to his wound his arm was saved, and in addition to appearance is of some use.

"Two wounds of a similar description were received from cannon-balls, by two seamen of Commodore Macdonough's fleet, on the 11th of September, 1814, in Plattsburgh Bay. Upon both I applied the first dressings. Fragments of the

humerus, clavicle, and acromion process, adhering to the lacerated muscles, were removed, as well as such portions of the muscles as appeared to be deadened by the ball; the end of the fractured humerus, which presented itself through the wound, was removed as low as possible with the saw: the superior extremity of the humerus, which remained in the socket, was detached by dividing its ligaments. The sound muscles which remained with the skin were secured by straps of adhesive plaister in as close contact as possible, without giving pain; the arm was permitted to retract to favour this contact.

"Large sloughings succeeded for some considerable time; the patients were supported with a soft generous diet, wine in moderate quantity, and bark, and eventually recovered. A maimed arm is preferable to no arm, if only for its appearance."

Of the cases alluded to, of injury of the head of the humerus, occurring at the battle of Waterloo, four came again under my observation, in a particular manner, in the York Hospital at Chelsea.

George Burnet, of the 92d regiment, was wounded at the battle of Waterloo by a musket-ball, which entered near the anterior edge of the deltoid muscle, passed through the head of the humerus, and came out near the posterior edge of the same muscle. He was treated successively in the general hospitals at Antwerp, Yarmouth, Colchester, and Chatham, and was admitted into the York Hospital on the 13th of November, 1816. A great many pieces of bone had been extracted at different times previously to this date, and they were evidently portions of the head of the humerus. The motion of the shoulder-joint was lost, but the pronation and supination of the hand could be readily effected, as well as the movements of the fingers, and nearly of the elbow-joint. The opening of the entrance of the ball, and one that was made towards the back part, in August, 1815, by incision, were discharging freely. The place where the ball had passed out

was marked by a cicatrix. In December the shoulder became inflamed, an incision was made into it and a piece of bone extracted, from which he obtained considerable relief. In January, 1817, the probe could be passed from the anterior to the original opening and exit of the ball, which had ulcerated, and allowed some small pieces of bone to come away. In February the probe could still be passed, but no pieces of bone could be felt, the discharge diminished, and he suffered little or no inconvenience from it. In May the probe could not be passed, the discharge was very trifling, and the openings were closing. In July 1817, two years after the receipt of the injury, he was discharged, with a pension, free from inconvenience, save that which arose from the loss of motion in the joint, but which he did not mind, as he had the use of the fore-arm, and a certain movement of the shoulder, depending on the greater power he had acquired of moving the scapula.

Anthony Chitty, of the 95th regiment, the subject of the second case, when he presented himself at the York Hospital in 1817, was perfectly cured. The wound had been at the upper part of the right arm, and implicating the head of the humerus, the deficiency of which could be distinguished through the cicatrix. This man had been principally under the care of Staff-surgeons Blicke and Swallow, who had removed the portions of the bone, and to whose ability he was indebted for his recovery. He retained a considerable degree of motion in the shoulder-joint.

The third case was nearly of the same nature as the second, but the injury was not quite so extensive. The fourth is the case, the particulars of which Mr. Morel, Deputy Inspector of Hospitals, and Surgeon to the Westminster Hospital, has related in the seventh volume of the Medical and Chirurgical Transactions, which I here subjoin.

" Thomas Ellard, a private in the 18th hussars, aged 32, strong, muscular, and apparently free from any kind of disease, was admitted a patient of York Hospital, September

13th, 1815, for a gun-shot wound of the left shoulder, received at the battle of Waterloo.

" The ball had passed through the head of the os humeri, about an inch and a half below the scapular extremity of the clavicle, as may be seen by a reference to the annexed Plate. In addition to the two wounds made by the entrance and exit of the ball, there was a third occasioned by an abscess which had formed, and which had been opened, and from which some small fragments of bone had been extracted. The situation of this latter opening was a little below the insertion of the pectoralis major, and upon examination with the probe was found to communicate with two former ones. In whatever direction the instrument passed, shattered pieces of bone could be felt.

" From the long and constant irritation kept up by the fractured portions of the head of the bone, and the profuse discharge of offensive matter which they occasioned, the health of the patient was evidently on the decline; and as it clearly appeared that nature of herself was unable to remove the offending cause, there remained the alternative of either removing the member at its articulation with the scapula, or of attempting to preserve it by cutting out the shattered portions of the bone.

" The advantages likely to result to the patient in point of seemliness, utility, and comfort, from the latter operation, should it prove successful, were so obvious, that I hesitated not to prefer it; and on explaining to the patient the circumstances which rendered the operation necessary, he very readily gave his consent.

" On the 22d of November, in the presence of most of the medical officers of the York Hospital, and other gentlemen, an assistant having made pressure with a boot-hook wrapt up in a piece of lint, upon the subclavian artery, as it passes over the first rib, I made an incision through the integuments and deltoid muscle (vide the last Plate); commencing at the upper orifice, and continuing it in a semilunar direction to the

opposite side, with the intention of forming a flap, similar to that which is made when the arm is to be removed at the articulation.

"In dissecting the deltoid muscle from its connection with the bone, I had some difficulty; the cellular membrane having acquired a cartilaginous thickness. The flap being raised up, I dissected a little round the head of the bone, and then introduced my finger, which passed through it; several splinters were felt adhering to, and entangled with the muscles. As the separation of these pieces would have been tedious, and the sufferings of the patient thereby unnecessarily prolonged, I proceeded to the removal of the head of the bone, by dissecting round it as well as circumstances would allow, which was accomplished, not without some difficulty, as the capsular ligament was considerably thickened, and with the head of the bone formed one confused mass. This, however, being effected, I, by the application of the saw to that part of the bone into which the tendon of the pectoralis major is inserted, removed the anterior half of the bone, and with it two smaller fragments. This gave me an opportunity of examining the remaining half of the bone, which was thrown back under the edge of the cup of the scapula, or glenoid cavity, as it is called. To remove this, it became necessary to separate the capsular ligament from its connection with the neck of the bone, and to divide the contiguous muscles, *viz.* teres major, pectoralis major, latissimus dorsi, and subscapularis. The remaining portion of the bone being now removed by the saw, the flap was brought down and preserved in contact with the lower portion of the deltoid muscle by slips of adhesive plaister, compress, and bandage.

"This operation took up nearly three quarters of an hour. Two arteries only required the ligature. On sawing through the posterior portion of the bone, an artery sprang from the interior substance of it; but the hæmorrhage was immediately suppressed by a dossil of lint dipt in spirits of turpentine. I should suppose that the man might lose during the operation

about two pounds of blood, an occurrence to be considered rather as favourable than otherwise. He bore the operation with great firmness; was carried to his bed; the shoulder and arm ordered to be kept constantly wet with cloths dipt into cold water, and in the evening an opiate was administered. I visited him in the evening, and found him in all respects as well as I could wish.

"23d. I visited him about ten o'clock this morning; found him in good spirits; slept but little during the night, and complained only of soreness: skin moist; tongue clean; countenance cheerful; pulse about 120. He was put upon spoon diet, and the opiate ordered to be repeated.

"24th. Slept pretty well, and said he was not in any one respect worse than he was before the operation.

"This morning I removed the dressings, which from their stiffness had occasioned some uneasiness, and found all quiet; perfectly free from pain, inflammation, or tension; edges of the wound in contact; skin temperate; pulse 102; tongue clean; slept a little at intervals; rather languid. Not having had an evacuation since the operation, I gave him half an ounce of sulphate of magnesia in a little peppermint water, and repeated the opiate in the evening; a small quantity of broth was allowed.

"26th. Slept pretty well; complains of pain this morning; pulse as usual; slight nausea at stomach; as the salts had not the desired effect, a common injection was prescribed; wound appeared clean and healthy; on the removal of the dressings, a small quantity of well-formed pus issued from the anterior shot-hole. Rice-pudding was allowed to-day, in lieu of the broth, which he did not relish.

"27th. Passed the preceding night ill; shoulder, on inspection, swollen and inflamed; pulse 100 and quick. In the early part of the morning, feet chilly. On removal of the dressings, a considerable quantity of pus discharged itself from the anterior shot-hole; the posterior part of the wound was united, by florid and healthy granulations. After visiting the

hospital, I returned again, and found that the injection had been discharged without bringing away any fæces. I accordingly prescribed the following medicine:

"℞. Magnes. sulph. ..... ℥ss,
Aq. menth. sativ. aq. puræ aa..... ℥iv,
Spirit. pimento..... .... ℥ j.

M. A fourth part to be taken immediately, and repeated every two hours until the bowels shall have been well emptied.

"Two doses of this mixture produced a copious evacuation. In the evening I found him greatly relieved; arm less inflamed; skin moist; pulse rather quick and languid. On account of his bowels having been a little ruffled by the salts, I added this evening, confect. aromat. ʒj to the night draught.

"28th. Perspired freely during the night, but did not sleep; tongue clean; pulse reduced to about 76; free from pain. In the course of the night had two evacuations; discharge copious, but of good colour and consistence; has had no return of chills.

"29th. Slept well; pulse soft and natural; discharge good, and diminished in quantity; appetite good. Having expressed a desire for some fish, I indulged him with a small quantity; and some port wine and water, weak, was also allowed. The opiate was repeated in the evening.

"30th. Slept well; had a stool early in the morning; in all respects as on the preceding day; some coffee was given in lieu of the tea, which disagreed with his stomach.

"Dec. 1st. Slept well; had two stools in the course of yesterday; wound clean; granulations healthy; discharge moderate; appetite good; diet ordered to be continued; opiate at night omitted.

"2d. No alteration since yesterday.

"3d. Slept well; discharge moderate and good; bowels inclined to be costive; wound florid; the arm appears to be shortening, the consequence of the retraction of the muscles; the upper part of the shaft of the bone may be distinguished by the touch, extending rather forward towards the axilla

than in the direction of the glenoid cavity. I therefore brought the arm a little over the breast, and by means of a compress and splint applied to the inside of the arm, extending from the axilla to the internal condyle of the humerus, kept it at some little distance from the side. The fore-arm was well supported by a sling, to which was applied a strap that passed round the neck.

"4th and 5th. Has not any thing to complain of, and sleeps well; granulations increasing fast.

6th to 11th. No change has taken place except the rapid increase of the granulations, which I ordered to be repressed by bandage and lint, dipt in a solution of cuprum vitriolatum, in water.

"12th. Had a slight rigor in the evening, and complained of being cold, particularly in his feet; pulse 120, with headach and thirst. Some castor-oil had been given before I arrived, which produced sickness, and he vomited a considerable quantity of bile; and in the course of the evening had several evacuations. This sudden change I attributed to indigestion brought on by too early an alteration of his diet; I therefore discontinued the fish, and put him again upon broth made of lean beef.

"His stomach and bowels having been considerably disturbed, I found it necessary to adminster the following cordial mixture, of which he took occasionally two or three tablespoonfuls:

"℞. Mistur. camphor..... ℥ ij,
Aq. puræ..... ℥ vj,
Confect. aromat. ..... ℥ ij.
M.

"13th. Slept a little during the night; stomach and bowels quite easy. The lower orifice, where the abscess had been opened, was slightly inflamed, and another appeared to be forming.

"14th. Found, on visiting him this morning, that he had passed a restless night; was sick, and generally uneasy;

looked sallow, and for the first time since the operation, seemed out of spirits; bowels not open; an abscess had formed near the lower orifice; ordered the arm and shoulder to be well fomented, and afterwards a poultice of linseed meal to be applied, and an injection of thin gruel, with a little salt and olive-oil, to be thrown up in the evening, if necessary. This was had recourse to, and produced an evacuation.

"15th. Inflammation diminished; some matter issued from the lower orifice; perspired copiously during the night skin moist; tongue clean; pulse soft and regular; ordered the mixture to be discontinued, but the poultice to be repeated.

"16th. Slept well; inflammation abated, and discharge lessened; in all respects better than on the preceding day.

"To the 23d. Continues to improve daily.

"24th. Discharge trifling; inflammation entirely gone; wound nearly healed.

"26th. Sleeps well; appetite good; countenance clear; is growing fat; wound healed; slight moisture from the lower orifice.

"Jan. 3d, 1816. The wound requires no further dressing, and the man is in excellent health. The distance between the cup of the scapula, and the extremity of the humerus, is not more than an inch and a half. On measuring the arm from the top of the acromion to the points of the elbow, the difference between it and the other arm is about one inch and a fourth. There is a little motion in the shoulder, but all the variety of motions of which the fore-arm and hand are capable are preserved, and he is daily acquiring more strength."

Upon this case Mr. Charles Bell has thought proper to make some critical remarks, which, as they are practical, require to be corrected. 1st, He has objected to the mode of operating; and 2d, He has advised another, *viz.* that of making a perpendicular incision in the deltoid; in both of which points he is in error, and from the simple circumstance that he was unacquainted with the state into which the parts fall, when

affected in a manner requiring the operation, after a certain lapse of time.

The operation for the removal of the head of the humerus is by no means difficult, when done in a case of recent injury, after the method Mr. White adopted in 1768, and which has since been recommended by the Barons Percy, Larrey, and others, as I have fully shown, and which Mr. Bell claims as his own. It is however a more troublesome operation than that of amputation, and requires much more subsequent care. It is done in the following manner.

The patient should be placed upon a low chair properly supported, the tourniquet recommended in the operation at the shoulder being ready for application if necessary. As it is impossible the state of the bone below the fracture can be exactly ascertained until examined, it is advisable that the incision made for its extraction be in such a situation, as to permit the operation of amputation to be performed with advantage. If, upon examining the head of the bone, the body of the humerus is supposed to be uninjured, an incision is to be made directly downwards from a little below the acromion, for three or four inches, or as circumstances may require, the arm being kept close to the side, as it allows a dependent opening for the discharge of matter, and does not interfere with the operation of amputation in the manner recommended: or, if the nature of the gun-shot wound render it advisable, the flap may be preserved, as recommended page 449 in the operation of amputation. In either case, the parts being separated by the fingers of an assistant, or of the operator's left hand, and the deltoid flap being raised up, the joint is brought into view: searching for the tuberosities of the humerus, the long tendon of the biceps flexor cubiti is to be cut as it enters the joint running between them, by which the head of the bone is a little relieved from its connection with the scapula, and sinks downwards, when the blunt bistoury in a firm handle readily cuts on the outside the attachment of the supra-spinatus, infra-spinatus, and teres minor. The bistoury is then to be brought

towards the inside of the arm; the fingers of the left hand are to be placed in the axilla, so as to press the head of the bone outwards and forwards, this motion being assisted if possible by the rotation of the arm, when the attachment of the subscapularis, with the rest of the fore and lateral part of the capsular ligament, can be divided. The bone is then only attached to the glenoid cavity by the capsular ligament on the back part, which may be readily got at and divided, always taking care to keep the cutting edge of the instrument next the bone, and the back towards the artery. The humerus can then be forced upwards and may be carefully sawed off, the bleeding vessels tied, as much as possible of the capsular ligament removed, and the humerus a little raised towards the scapula; the edges of the wound are to be approximated by adhesive plaisters, and retained by a bandage constantly wetted with cold water, until the inflammatory symptoms are restrained within due bounds; when a pad is to be placed in the axilla to keep out the lower end of the bone in a line with the glenoid cavity.

If, however, in dividing the attachment of the teres minor on the outside, care be not taken to keep the knife close to the head of the bone, the posterior circumflex artery may be divided as it rises up round the bone between the insertion of the teres minor and the teres major, having the long head of the triceps on its outside:—if this should be divided, it is not of any consequence, save that compression must be made upon the subclavian artery until it be secured. If the anterior circumflex be divided on the inside it must also be tied, but this vessel is generally of less importance. If by any accident the operator should wound the axillary artery, which can scarcely happen, he must secure it with a ligature, and be ready to amputate the limb. See p. 424.

After the inflammatory symptoms are over, the body of the humerus must be brought in contact with the glenoid cavity of the scapula, and retained in that situation until the wound be healed; it is obvious the greatest attention must be paid in

dressing it, to prevent collections of matter of any kind, and to give free vent to them if formed; an exfoliation from the sawed end of the humerus will sometimes take place; and, if particular care be not taken to repress and allay symptoms as they arise, the patient may become hectic, and die.

It must be evident to every one acquainted with the nature and the anatomy of the parts, and especially to those who have practised this operation on the dead body, that it can only be accomplished with facility when the parts possess their natural flexibility; when the flaps made in the deltoid can be separated from each other, so as to admit of a knife being introduced to cut the insertions of the muscles into the two tuberosities and the capsular ligament, and when a certain degree of motion remains in the joint to assist in this object. When the injury is recent, the parts are in this state, and a surgeon acquainted with their anatomy can perform the operation with a degree of difficulty which will be more justly estimated by those who will attempt it on the dead body. This difficulty is increased, according to the greater or less degree of rigidity of the parts, and if they should have become nearly inflexible from disease, it is almost impossible to effect it by a single incision. Into this state the parts about the shoulder fall, when the head and neck of the humerus have been seriously injured, and disease has been allowed to go on for several months. The periosteum covering the bone becomes greatly thickened, the shaft of the bone inflames and is softened, or dies, constituting necrosis; the head of the bone becomes carious, the capsular ligament is considerably thickened, where it is not actually ulcerated and destroyed. The insertions of the muscles partake of the same thickening as the periosteum and the cellular substance, so that, on cutting through the deltoid muscle down to the bone, it has more the appearance of a ligamento-cartilaginous substance, than muscle and cellular membrane. When the incision is made, the parts will not separate, and no more is gained than is actually cut with the knife. The same thing takes place in necrosis of the thigh-bone, and constitutes one of the

great difficulties experienced in treating necrosis of that bone from gun-shot fracture. This was precisely the state of parts in the case of Ellard, not one quarter of an inch was gained at any time but by actual cutting. I assisted Mr. Morel in the operation, I know this to be the fact, and it sufficiently accounts for the length of time required in the performance of it, and the loss of blood. In this state of parts there was nothing peculiar, it always takes place in an advanced stage of disease; and if Mr. Charles Bell had been thoroughly acquainted with the subject upon which he was writing, he would have known that it was so; he would not have hazarded the criticism he has done, and the recommendation of another method of performing the operation, which I trust I have satisfactorily shown is nearly impracticable, from natural and unfavourable causes, in the state and at the period alluded to. Even with the transverse division of the deltoid muscle, the separation of the head of the bone from the glenoid cavity was accomplished with great difficulty. The bone was splintered as low as the upper edge of the insertion of the pectoralis major, which, as well as the insertions of the teres major and latissimus dorsi, were thickened, and nearly as hard as cartilage. It became necessary to cut a portion of these insertions, in addition to every other part that could retain the head of the humerus against the glenoid cavity of the scapula, and prevent its being drawn sufficiently outwards to allow of its being sawn off. The statement of the case which Mr. Morel drew up himself, without showing it to any one of his friends, proves in the best possible manner the advantages of the method and the propriety of the after-treatment. It was written to answer no particular purpose beyond the general interests of science; and the little verbal inaccuracy which Mr. Morel fell into, of substituting subclavius for subscapularis, and which Mr. Bell seized upon with avidity in order to charge him with negligence of anatomy, Mr. Morel is willing to grant him such benefit of, as he is likely to derive from it.

Mr. Bell says, "The head of the bone being extracted,

and the connections of the humerus lost with the scapula, and the deltoid cut across, the pectoralis major and the latissimus dorsi had drawn the end of the bone towards the side, the consequence of which was, that the bone lay irritating the skin on the inside, and an abscess had formed there." This statement is an error: no such abscess formed; the bone was kept out from the side by a proper compress, and no matter formed from any cause that could have been avoided. He further says, "On the subject of this operation generally, I have only to add, that if at any time it shall be necessary to make an incision across the arm, the middle portion of the deltoid should be preserved entire, to be a counterpoise to the pectoralis major, or latissimus dorsi." This, from a man of less reputation than Mr. Charles Bell, might be passed over, but from him it deserves remark. When a simple fracture takes place of the neck of the humerus, in adults (or if the head of the bone be separated as an epiphysis in young subjects), the lower end of the bone is felt in the armpit, drawn inwards by the very muscles to which the central part of the deltoid is to act as a counterpoise; and the restoration of the lower end of the bone to its place, and its retention there, constitute the principal points of the treatment. To effect this, it is necessary that the lower end of the bone should be prevented mechanically (that is, by padding or filling up the armpit) from passing inwards*, although the central fibres of the deltoid are perfectly uninjured. Mr. C. Bell could not have been ignorant of this fact in surgery; yet what the fibres of the deltoid are incapable of doing in a comparatively trifling injury, he considers them capable of performing in a much more severe one; and how the operation was to be done in this manner, which I have shown to be impracticable, he does not venture to explain.

Mr. C. Bell has charged the medical officers of York

* See on this subject Boyer on the Diseases of the Bones, page 150 & seq. vol. i.

Hospital with having confused notions on the subject of this operation, and with negligence of the anatomy of the parts. I now appeal to the profession to decide with whom the confusion of ideas, and the negligence, really exists.

Mr. C. Bell remarks, that the Baron Larrey has been quoted on this point with high consideration, and says, that the cases of Mr. White and the surgeon of Pezenas have nothing to do with the question before us, and that "if they be brought forward now with the laudable intention of giving to every one his due, this sort of justice is done with the unfortunate effect of drawing off the young military surgeon from the just knowledge of the case, and obscuring his understanding of the question in practice." In other words, this means, "that by making the young military surgeon acquainted with the successive steps taken at different periods to bring the operation to its present state, it shows him that Mr. Bell has nothing to do with the improvement he claims." For, how making any man perfectly acquainted with the history of an operation can obscure his understanding as to the application of it, Mr. Bell does not explain; and if it should have that effect, the necessity for reading is at an end; and a surgeon who is totally unacquainted with what has been done before his own time, must be a much better one than he whose mind is stored with all the knowledge of his predecessors.

The Baron Larrey must always be quoted with consideration, because he wrote from practical observation; and Mr. Bell, who had read his works, although he has not quoted him, appears to have copied from him on almost every occasion. His last method of amputating at the shoulder joint, is that recommended by the Baron, and the reverse of the one he advised to be done in 1814. His recommendation to extract the broken pieces of bone from the shoulder-joint, instead of amputating the arm, is nearly the same as the Baron's. The works of Larrey were in England, and were reviewed, and this particular part noticed long before Mr. Bell wrote; and I have shown that the same practice was pursued in the Peninsular war at

least as early as 1812; see page 480. When Mr. Bell says, that I have admitted too great an attachment to the operation of amputation, he shows that I wrote faithfully, that I did not intend to point out only the good, but, by stating the bad, to banish it from practice. That several surgeons, whose opportunities were not so extensive as those of others, should prefer amputation in every case, is not extraordinary; Baron Larrey, in the fourth volume of his Memoirs, which includes the campaigns in Russia, Saxony, and France, does not give one instance of this operation having been done, although he mentions at least forty operations at the shoulder-joint. The reason of this may be found, in all probability, in the peculiar situation of the French army, which did not admit of the attention being paid, and the rest allowed, which excision of the head of the humerus requires, but which amputation does not demand. Employed during the whole of the Peninsular war, from the first battle to the last, with the exception of the battle of Busaco, when I was absent for a short time in consequence of fever, acquired in the plains of the Guadiana from excess of duty as well as from situation, I had not an opportunity of seeing the works of the Baron Larrey until they were lent to me by his uncle at Toulouse after the battle. The coincidence which will be found on many points in our sentiments arose, then, from practical observations made independently of each other, and are therefore the more to be relied upon.

Having shown, then, in the most positive manner, by a relation of the particular cases, that it was not the practice of the surgeons during the Peninsular war to remove the arm in every case where the head of the humerus was injured, but only when the joint was *materially* affected, I trust I have sufficiently disproved the boasting of Mr. Bell, that "I shall not be denied the agreeable reflection of having roused the army surgeons to a juster notion of those cases, and of being eventually the cause of saving many a brave fellow's limb."

So far from Mr. C. Bell having instructed the army sur-

geons, the fact is precisely the reverse; for, when my book was published in 1815, there was scarcely an error which it pointed out, that he did not teach; and whoever will take the trouble to compare his prior with his later writings, will find, that he has abandoned them, but without any acknowledgment. Neither the medical officers of the army or navy have the least objection to be instructed by Mr. Bell, or any one else; on the contrary, they are desirous of obtaining, and of acknowledging it, from whatever quarter it may be proffered; but they are not desirous of, neither will they submit to, having their own opinions appropriated by another, who never perhaps, even in a single instance, put them into practice. As far as I have hitherto gone, I have shown, that the practice I have recommended was pursued prior to Mr. Bell's having written one line on the subject, and unless he can prove that the cases I have referred to are false, he cannot satisfy any honourable man as to the justice of the claims he sets up. That every surgeon in the army did not follow the same methods, is not intended to be disputed, for there were many who had not sufficient opportunities of forming an opinion. There are many, even in London, under the same circumstances as to every part of surgery; and it would be as unfair of any army surgeon to estimate the practice of all the surgeons in London, from what he might see done by these persons, as it is of Mr. Bell to state the general practice of the surgeons of the army from the errors of a few, or from what may have occurred in moments of almost unexampled difficulty. Admitting the surgery of the hospital to which Mr. Bell belongs to be as good as it ought to be, according to the present state of our knowledge, for I have no wish to injure his fairly acquired reputation, and supposing that instead of 30, he had 300 cases, requiring either operation, or the greatest care, suddenly thrown upon him, without the means of obtaining further assistance, without bedding, and partly without food, I would ask him what he would think of any man, who, at the end of a few days, should state what he saw in this peculiar

situation to be Mr. Bell's practice under more favourable circumstances. He could not have done even half the necessary operations; and, obliged to give a partial attention to all, few could receive that which they absolutely required. It was under such circumstances Mr. Bell saw the wounded a few days after the battle of Waterloo, and therefore he was not in a situation to draw one general inference as to the mode of treatment.

In order to prevent any misunderstanding as to my opinions on the subject of injury to the shoulder, I shall, in addition to the observations already made, draw the following conclusions:—

1. That no injury of the soft parts, which is likely ever to occur, authorizes amputation as a primary operation.

2. That when the bone is injured, three different operations may be necessary—amputation, excision, and the removal of the splintered pieces of bone by incision.

3. The cases in which amputation is necessary, are mentioned from page 421 to 427. It must not, however, be forgotten, that peculiarity of circumstances will often render the more severe mode the most eligible.

4. The different cases I have noticed, in which serious injuries by cannon-shot have not rendered amputation necessary, would lead to the hope that it might generally be dispensed with. The constitution, and the situation in which the patient is placed, should have great influence in deciding what is to be done, when there is any doubt what method ought to be adopted. Wherever I have said that amputation or excision *may*, or must be performed, I prefer the latter, where concomitant circumstances are favourable to recovery; and the former, where they are the reverse. A wound from a musket-ball can rarely render amputation necessary, unless the artery be divided, with fracture of the bone, as is mentioned at page 424.

5. When the head of the bone is injured, the rule of practice is to enlarge the wound in the first instance, to allow of

a moderate examination with the point of the finger, if it cannot be done by the openings already made, and any loose pieces of bone are to be removed. The most energetic antiphlogistic regimen is to be enforced, according to the directions already given, until suppuration is established; a clear depending opening is then to be formed, if it do not exist, for the discharge of the matter, and any pieces of bone which appear loose are to be gently removed. The joint is not to be wantonly opened into at first, to see how much bone may be injured; but it is to be cut into, if necessary, to allow of the removal of any piece of bone which may be irritating the parts, and cannot be easily extracted without it, and when the head of the bone is separated from the body, or shaft, the fractured part of the humerus should be removed by the saw. The principal point to attend to is the prevention of sinuses around the joint, which would ultimately destroy the patient, and this is to be done by depending openings, position, proper compress and bandage. Amputation is a last, but then not always a successful resource.

Of Amputation of the Arm.

This operation, perhaps the simplest in the list of those usually considered of importance, has frequently been confined to the space between the elbow-joint and the insertion of the pectoralis major; and where the injury, affecting the bone, has extended higher than this point, amputation at the shoulder has been recommended in preference to cutting through this and other muscular attachments, and sawing off the bone near to its tuberosities. The Baron Larrey*, who, in general, I consider as one of the first authorities in Military Surgery, says, " When the injury affecting the arm extends very high up, instead of preserving a short stump formed by the upper

* Tome iii, page 53—400.

end of the bone, it is better to amputate at the shoulder; for if the section of the humerus cannot, at least, be effected on a level with the tendinous insertion of the deltoid, the stump is retracted towards the armpit by the pectoralis major and the latissimus dorsi. The ligatures on the vessels, which must be made high in the axilla, irritate the brachial plexus of nerves, and increase the retraction, which is attended by pain and nervous twitchings, extremely uncomfortable to the patient, and which frequently bring on tetanus; the stump always remains swelled, and at last the humerus anchyloses to the shoulder, so that this portion of the arm is altogether useless to the sufferer, and renders him liable to frequent accidents. I have seen many officers and soldiers of all ranks, who regretted, from these causes, that they had not lost their arm at the shoulder."

When amputation by the circular incision is attempted at the insertion of the pectoralis major, it is seldom that the bone will not protrude after a few dressings; and frequently a disagreeable and painful stump is the consequence. If a tourniquet be used, a great difficulty occurs in securing the artery, which will not bleed, from having retracted into the axilla from the first moment of the incision, and having been during the remainder of the operation compressed at its divided end by the strap of the tourniquet; a needle is then resorted to, and much mischief committed. I was called after the battle of Salamanca to an officer, operated upon precisely under these circumstances, in whom a profuse hæmorrhage took place from the axillary artery, which in a few moments caused him to faint, and by this sudden and great loss of blood preserved his life. It was presumed the head of the bone must be extirpated, and the diseased parts removed, so as to render it a fresh incised wound, in which the vessel could be safely secured. The young gentleman was, however, so nearly exhausted, that this plan did not appear feasible; and as the artery ceased to bleed, it was determined to wait until he gained a little more strength, or the recurrence of the hæmorrhage should render

an operation necessary; due assistance to prevent accident being always with him. The hæmorrhage never returned, the coagula and foul dressings were in three days removed, his strength gradually recovered, and in due time, allowing for the protruded end of the bone to exfoliate, he was cured. I have been always of opinion, that the artery never was included in the ligature, as the surgeon himself was doubtful of it, and the operation had been performed in the dusk of the evening.

After the battle of Albuhera a similar circumstance would have occurred to myself, if I had not taken off the tourniquet, and even searched in the axilla by dissection for the artery, before it could be secured.

Since that period, I have abstained from performing amputation by the circular incision, when the bone cannot be sawed below the insertion of the pectoralis major; but I must dissent entirely from the opinion of M. Larrey and the French surgeons, who recommend, under these circumstances, amputation at the shoulder; for all the advantages of this operation may be gained, and any disadvantages attending it avoided, by sawing the bone from half an inch to an inch and a half below the tuberosities of the humerus, as the nature of the injury may render it necessary. The artery is easily and safely secured, the nerves are readily separated from the vessels, the stump neither swells nor becomes affected in any way different from a common amputation; the bone is remarkably well covered; there is little or no fear of retraction of the integuments, the rotundity of the shoulder is preserved, and the deformity following amputation at the joint is in a great measure avoided.

The operation is performed as follows: —

The patient is to be seated, and compression made upon the subclavian artery in the same manner, and with the same instrument as in amputation at the shoulder, in preference to using a tourniquet, with a pad in the axilla, which is a source of great inconvenience in every step of the operation. Two incisions, of a similar shape, are to be commenced, one or two

fingers' breadth below the acromion, as the case may require, the point of the inner one, instead of ceasing, as in the operation of the shoulder, a little below the pectoral muscle, is to be carried directly across the under part to meet the point of the outer incision; so that the under part of the arm is cut by a circular incision, the upper in the same manner as in the operation at the shoulder: these incisions are only through the skin and cellular membrane, which is at liberty to retract, but is not to be turned up. The deltoid and pectoralis major are then to be divided close to the inner incision, and the opposite portion of the deltoid, on the outside, with the long head of the biceps for the extent of the outer incision. A half circular cut on the under part, in the line of the skin down to the bone, clears it underneath, and shows the artery retracting with its open mouth, which is at this moment advantageously pulled out by a tenaculum and secured. The flaps are turned outwards and inwards, and particularly the outer one, until the bone is cleared to the spot of election for sawing, which is then readily effected from the outside, without danger of doing mischief. The tendon of the latissimus dorsi and the teres major, inserted on the under part, do not require to be cleared away too carefully, as they materially help to keep the bone steady under the motion of the saw, and effectually prevent its splintering. There are few or no vessels to tie, the flaps are brought forwards and upwards, and perfectly cover the stump; one suture below the end of the bone keeps the parts together, which form nearly a line from the acromion downwards. The wound over the bone heals generally by the first intention, the ligatures soon come away, and the cure is completed in as short a period as in other amputations.

Corporal M'Kenna, of the 36th regiment, was wounded at the battle of Toulouse by a musket-ball in the left arm, which fractured the bone at its lower half, and injured the joint of the elbow; four weeks after the accident the arm to the insertion of the pectoralis major being in a state of disease, and the man's general health seriously affected, I performed the

operation in the way described, before the military surgeons on duty, and the French surgeons of the town; not an inch of bone being left, exclusive of the head of the humerus. Except slight pain the first twenty-four hours, from the bandages being too tight, the man suffered little inconvenience: the bone was covered in nearly by the first intention, and the ligatures came away, leaving in three weeks merely a line from the acromion downward; the man accompanied me to Bourdeaux the beginning of July, on his way to England, in perfect health, having never after the first few days of the operation suffered any inconvenience in the stump.

Corporal Wm. Robinson, of the 48th regiment, was wounded at the battle of Toulouse, by the explosion of a shell, which rendered the immediate amputation of the right leg necessary; and fractured the bone of the arm of the same side, opening extensively into the elbow-joint. The amputated leg doing well, but the constitution becoming affected from the state of the arm, the integuments of which were much injured and diseased, I removed it in the same way on the 1st of May, eighteen days after the receipt of the injury. The greater part of the incision, and particularly that over the bone, healed by the first intention, the lower part remaining after some days tolerably firm and compact; the ligatures came away regularly. At the end of the month there was merely a line of incision, at the lower part not quite cicatrized; when he perceived a little hardness at the under part of the wound, which gradually became a small swelling of the size of a marble, and in the beginning of June opened into the line of incision of the original wound, discharging about a tea-spoonful of pus, arising, as I conceive, from a small portion of the tendon of the pectoralis major having sloughed after having been surrounded and cut off from the external wound, by the process of adhesive inflammation. This discharge continued, but in small quantity, until the removal of the man to Bordeaux, when it nearly disappeared, and he embarked for England. On his arrival at Plymouth, on the 28th of July,

he walked about the streets, and was apparently well; this little abscess, however, from inattention or injury again collected, the opening into the external wound having closed, and on the 2d of August was opened with the point of a lancet; in the evening there was a trifling hæmorrhage, which was hastily suppressed by compression and the application of cold cloths. The following morning, on the removal of the dressings, the axillary artery bled furiously, and was scarcely restrained by the assistants, until the gentlemen in charge assembled, when the face of the stump was opened, and many attempts were made to secure the artery, but in vain; owing, it is supposed, to the diseased state of the parts surrounding the extremity of the vessel. It was then resolved to take up the subclavian artery, which was secured with some difficulty immediately below the clavicle in the following manner, by Mr. Downing, Deputy Inspector of Hospitals, assisted by Staff-surgeon Dease, who had the care of the man from Toulouse to Plymouth. An incision commencing at the centre of the clavicle was carried down to the inferior part of the axilla, where the abscess had pointed, the great pectoral muscle was then cut through, the lesser pectoral and some fillets of the subclavian also. Then by a careful dissection and removal of cellular substance and fascia the artery was laid bare. During the dissection one or two small branches sprang, which were secured; the great difficulty then existed in the want of an instrument adapted to the space where the artery lay, the projecting coracoid process of the scapula on one side, and the clavicle above, leaving it quite a deep and narrow space: this was effected with considerable difficulty, by giving to a probe a curve adapted to the space; the bare passing of which took at least one hour, so great was the difficulty, owing to its being too flexible, and the curve giving way. The ligature came away in a reasonable time, the man was discharged the hospital cured, and is now at Chelsea.

On the embarkation of this man for England, I recommended a director to be passed in the course of the external

wound, and the little abscess to be laid open; but Mr. Dease thought it unnecessary during the passage, the discharge being so small; and it appears to have been nearly sound on his arrival at Plymouth, when changing his medical attendant, and being during five days nearly at large, and drinking hard, the little abscess again formed. The artery must then have ulcerated in it, or it was wounded by the point of the lancet with which it was opened; whichever of these circumstances did really occur, neither affects the operation as it was originally performed. The first abscess, which I saw, arose, I believe, from the tendinous end of the pectoralis having sloughed, an accident likely to happen, both in this operation and at the shoulder; and in another case of this kind I would recommend its being fairly laid open by a scalpel and director; and if the artery give way from any cause, to cut down upon it in the direction of its course from the clavicle, instead of searching for it on the face of the stump, or attempting to secure it with the needle.

I first performed the operation at Salamanca, having seen the defects of the circular one at the battle of Albuhera, and the sieges of Ciudad Rodrigo and Badajos, and in consequence, I believe, of my recommendation of its general utility, it has since been performed in this manner in several cases with success, and particularly after the battle of Orthez, in which the operation at the joint would have otherwise been considered necessary; and when the operation is done in the way above described, and the parts united by the first intention, and I have seen several of them after the lapse of six years, it is not liable to any of the objections of M. Larrey. I have little hesitation in saying, that no one will perform the operation in this part of the arm by any other method yet described, who has either had an opportunity of doing it, or of seeing it done, by mine.

Amputation of the arm by the common circular incision is to be practised only in the space between the lower edge of the insertion of the pectoralis major, and the elbow-joint.

More serious wounds may be inflicted in this space, however, and the arm preserved, than in any other part of the extremities; arising from the great command the surgeon has over it, from the bone being single, and its state capable of being distinguished with tolerable accuracy during the continuance of the complaint, from the muscles being few in number, the interstices between them consequently less numerous, and from the great vessels being totally in our power. A wound in the arm is also less distressing to the patient than a proportionate one in the thigh or leg, and in common much less affects his general health.

Considering the great frequency of wounds in this part of the arm attended with fracture, amputation, as a primary operation, is but seldom requisite; and a just delay, to ascertain what nature assisted by art can do, is prudent.

No common flesh wound made either by cannon or musket shot, even including a division of the artery, absolutely demands the operation, the bone remaining sound, unless the laceration attending it be extensive in every direction; for nature can and will do much under these circumstances, when properly assisted: recourse is to be had to delay, until it be ascertained that the fore-arm or hand cannot be supported below, or that the extensive contusion is likely to bring on gangrene in the wound, when the operation is in time and admissible. If in addition the bone be broken, or if the bone be mashed with the muscles by an oblique stroke of a round shot, or the fore-arm be destroyed or carried away, it is required immediately.

The necessity for the operation after a wound from a cannon-shot is generally obvious, or the reverse; it is far different however in regard to wounds from musket-balls; the practice has altered considerably in the late campaigns, and arms that would have been amputated in 1800 were preserved in 1814, from the knowledge acquired by experience of the liberties that may be taken with impunity with this extremity.

A musket-ball passing through the centre of the os humeri

with considerable splintering of the bone, not extending to either of the joints, does not require the primary operation, however circumstances may subsequently render it necessary; and this rule of practice is so general among military surgeons, that I believe no one of experience has ever proposed amputation in a case of the kind, during the Peninsular war, without other particular reasons; and those practitioners in military surgery, whom Mr. C. Bell describes, at p. 475 of his valuable Dissertation on Gun-shot Wounds, included in his Operative Surgery, as stating to him, "that when the bone is fractured by the ball striking the bone, the arm is to be saved; but when the ball goes through the bone, and the finger introduced into the shot-hole feels the broken pieces on all sides, and that the ball has passed through the cavity of the bone, it is a case for amputation," were stating to him not the practice of military surgeons in general, or of the army in the Peninsula; but their own unconnected opinions, which are highly deserving of the censure he has passed upon them.

I cannot indeed conceive, that any thing could induce men of ability thus to depreciate their profession; and whatever situation these gentlemen might have held, I conclude it was ignorance of what was really done in the army, that made them state what they did; and when I connect this with Mr. Bell's observation, p. 459, "Among the soldiers from Spain, I have seen some whose wounds were scored, as if in religious ceremony, but the cuts were healed, while the narrow wounds remained full of slough;" I cannot help being perfectly satisfied that ignorance was conspicuously displayed to him; for I solemnly assert, that of 20,000 wounds I have seen from the first battle of Roliça, 1808, to that of Toulouse, in 1814, I never made an incision for the sake of simple dilatation; and I never saw but one that I can recollect made by any person, without some further legitimate object in view for such operation.

On the 17th of August, 1808, a few days after the arrival of Sir A. Wellesley in Portugal, Captain, now Lieutenant

Colonel Hodge, of the 29th regiment, was wounded on the heights of Roliça in the left arm by a soldier, who he distinctly saw taking aim at him at less than six yards distance. He came to me immediately afterwards at the foot of the hill, whilst still exposed to a severe fire of musketry. The ball had passed completely through the bone about its middle, and the lower part of the humerus and the fore-arm hung at a right angle with the upper extremity of it, when he was brought to me, as the surgeon of his regiment. I passed my finger between the bones at both shot-holes, removed all the small pieces that could be brought away, placed his arm in splints, and directed him to keep it constantly wet with cold water. This was done, suppuration came on in due time, an incision was made for the removal of a piece of bone that could not with propriety be brought away at first; and in two months, from the attentive care of the gentlemen at the Hospital at Caldas, he was enabled to remove to Lisbon with an arm perfectly firm, although not entirely healed. It is now no inconvenience or pain to him whatever; it is not quite so strong or so long as the other, but otherwise there is no defect. I relate this case of an officer merely because he is more referrible to as to the fact than a soldier; and I could produce numbers, both officers and soldiers, under the same circumstances; indeed, I very lately met a soldier of the same regiment wounded on the same day, the 17th of August, 1808, but much higher up, the ball having passed through the pectoralis muscle before it broke the arm, who is now able to earn his livelihood as a labourer, having all the use of his arm below the level of his shoulder: it was, however, a year before the wound healed in this instance. This man has been several times in the Westminster Hospital, once within the last year, and I showed the arm which had been broken to several of the students.

Lieutenant Colonel Sir Gregory Way, Deputy Adjutant General in Scotland, was wounded at the battle of Albuhera, by a musket-ball, which passed through the os humeri, im-

mediately below the tuberosities, causing considerable mischief in that part of the arm. I saw him shortly after the receipt of the injury, examined the wound, placed it in splints, directed the application of cold water to the part, and kept him under my own inspection for a month, until the first symptoms of inflammation had passed by. He has saved his arm, and has a good use of the fore-arm and hand, although deprived of that of the shoulder-joint.

Major Leahy, of the 23d, or Welch Fusiliers, was wounded at the assault of Badajos nearly in the same manner, and was treated by my direction in the same way. He recovered, however, with very little loss of motion or power in the arm.

Lieutenant General Sir Hussey Vivian was wounded in front of Toulouse, in a charge of cavalry, and had his arm broken by a musket-ball. The injury appeared of a dangerous character, and after he had been removed to a house in the neighbourhood, my opinion was requested on the propriety of amputation, but I did not hesitate to confirm that of Mr. Dease, who had first seen him, that the arm might be saved; and the result proved the correctness of our views.

I hope it will be believed from these cases, which were treated long before Mr. Bell wrote, that the gentlemen, who gave him the information above stated, led him into error; and in vindicating the medical department of the army from the censure he has passed upon it, I acknowledge it would have been just and highly proper, under the circumstances he has stated, and I am satisfied it will be more grateful to him to know, that we were not guilty of this bad practice, than to be assured that his censure was just.

If the artery be wounded with an extensive fracture, the operation is then imperious; but if it be wounded with merely a splintering of the bone, without complete solution of its continuity, or even if it be broken short across with little or no splintering, the vessel should be secured above and below, and the event carefully watched. I have no case in support

of the opinion, it is therefore more theoretical than practical, but I think it a case well deserving trial; for were the bone not absolutely broken, but only splintered, the arm would be saved, and were it even fractured across, delay would be prudent, provided the surgeon is capable of estimating symptoms, and has it in his power to pay his patient constant attention. If these advantages cannot be secured to him, amputation is to be preferred.

Here, as well as in every other case in which arteries are wounded, and continue to bleed, and in which I recommend an attempt to be made at saving the extremity, the state of the limb must be taken into consideration: if these vessels have thrown their blood directly out at the wound, without injecting the cellular membrane, the case is a good one; but if pressure has been inconsiderately made upon the wound, and the arm or leg be injected with blood, it is very disadvantageous, and when the bone is injured would determine for amputation; but where the artery or arteries only are wounded, it should not influence the practice to so great an extent, and if it be in the arm, or fore-arm, the vessels should be secured at each end, in parts unaffected by the motion of the ball, the extravasated blood pressed out by these wounds, or by others made through the skin and fascia, and the result, as before directed, awaited with attention. If the blood was thrown out in great quantity, and the hæmorrhage soon ceased, it is almost demonstrative that the artery has been fairly cut through, and it may give no more trouble; but if it continue to bleed, and in less quantity, it is more than probable that it is only wounded.

A simple wound of the fore-arm, superadded to a fracture of the humerus, is not a cause for operation; although a severe one, attended with fracture of the radius or ulna, will in general be a sufficient reason for performing it.

A wound of the brachial artery by a musket-ball, accompanied by another in the fore-arm of a simple nature, or the loss of a finger or thumb, or even the ends of two or three

fingers, is not a sufficient reason for immediate amputation of the arm: the vessel is to be secured, the fingers amputated, and the results carefully attended to. Any wound, destroying a great part of the hand, or joint of the wrist, would render the attempt at preservation of the arm not worth the risk attending it.

An incised wound into the elbow-joint, cutting off with it a part of the condyle of the humerus, or the head of the radius or ulna, requires the piece of bone only to be removed, and the flap laid down, when the cure will frequently be effected with a loss of motion of the arm, depending on the degree of injury. A gentleman at Lisbon, in 1813, received a cut of this description from a sword, which actually cut away a portion of the outer condyle of the humerus, which was brought to me. I desired that the fore-arm might be moderately bent, and the antiphlogistic treatment should be rigidly enforced. The patient perfectly recovered. If the wound be large, and the ligaments much divided, it will be better to proceed at once to amputation, as the succeeding inflammation and its consequences will in general destroy the patient, if it be not at last resorted to.

Wounds from musket-balls entering the joint of the elbow and fracturing only one of the bones, have seldom done well; they have generally terminated in cases of secondary amputation, after the cartilages had been destroyed, and anchylosis had failed to take place. From the failure of a great number of cases attempted to be preserved, I am satisfied that cures will not often be effected in military practice. Amputation is not however demanded as a primary operation, unless there be not only a scrofulous predisposition, but the appearances of scrofula existing in the system; when the operation is advisable.

If the artery in the bend of the arm be wounded, or the joint of the wrist or the carpal bones be injured, in addition to the injury of the elbow, the operation is to be performed.

A musket-ball passing through the elbow-joint, injuring

the articulating ends of the humerus, radius, and ulna, is a fair case for amputation above, as the joint cannot be saved by anchylosis, as has frequently been supposed; or if a case of this kind should occur, it is so infrequent, and gained with the loss of so many lives, as not to deserve consideration. A ball fracturing the olecranon process, and lodging in, or interfering with, the joint, is not a case for immediate amputation. Captain Heyliger, of the 7th hussars, was wounded in this manner at the battle of Waterloo; but having been treated by Assistant-surgeon Jeyes, of the 15th hussars, on the principles I have laid down, has saved a useful arm, although it has since that period been several times in danger.

A wound from a cannon-shot injuring the bones of the elbow-joint, demands immediate amputation, as the neighbouring parts are also generally much injured.

The operation being necessary, the patient should be placed upon a chair, and properly supported: the tourniquet is then to be applied in the usual manner with a small pad in the axilla, with the screw above the acromion, it being advisable to have the strap acting as far distant as possible on the muscles and skin to be divided, that free retraction may take place, and no impediment be offered by the pressure of the tourniquet on the soft parts, whilst retracting them for sawing the bone. If the surgeon have the slightest confidence in himself, and the assistants are good, no tourniquet should be applied, but the artery be compressed against the bone by the two fore-fingers. For my own part, I never apply a tourniquet; and I believe if by any accident the assistant should fail, the operator can without difficulty compress the artery himself, so as to prevent any evil consequence, and not interrupt the operation; and in the first case in which I tried the flap operation on the arm, I had to compress the artery against the head of the humerus with the left hand, whilst I sawed the bone with the right.

The assistant who compresses the artery should draw the

integuments upwards with both hands, and another assistant, if one be at hand, should put them on the stretch downwards towards the elbow-joint, when they are cut more readil y and with greater ease to the patient. The fore-arm is to be moderately bent.

A circular incision is to be made at one continued stroke, as quickly as possible, through the integuments down to the muscles, taking care that they be not cut, and that the artery on the inner and under part be especially avoided. The integuments thus cut are not to be dissected back, as is usually done, but separated by touching the slip of membrane which may still adhere to the muscles with the knife; the assistant still steadily retracting them as they recede on being loosened. The knife being then placed close to the incised integuments, the muscles and the vessels are to be divided, the incision commencing on the outside of the biceps, which is to be cut through, and carried in one sweep completely round. A second incision close to the edge of the retracted muscle cuts through the remaining parts down to the bone. The amputating knife being changed for a strong scalpel, the muscles are to be cleared from the bone for an inch and a half or two inches, as the thinness or wasting of the part may require for the sake of covering. The retractor is to be applied, and the periosteum to be divided by one circle drawn with the scalpel round the bone, and in the circle the saw is to work until the bone be divided. The retractor is to be removed, and the brachial artery drawn fairly out with a tenaculum, and tied. It will be found on the inner side of the arm. If it should have retracted out of sight, the finger on the vessel above is to be raised, or the tourniquet is to be loosened, when it will show itself, with perhaps two or three other vessels, which must be secured. The surface of the wound is to be sponged with cold water, and the integuments dried with a cloth, and the stump dressed in the same manner as in amputation of the thigh.

Excision of the Elbow-Joint.

I have already stated, that the operations of sawing off the articulating ends of bones, or cutting out the whole of the joints themselves, have not been practised in the British army, although my own opinion now is, that many cases do occur in the upper extremity in which they may be resorted to with advantage; and I recommend the observations of Messrs. Park, Moreau, and Jeffray, published by the latter, to the consideration of all military practitioners; premising, that the operations therein advised are only to be attempted by those who have a competent knowledge of the anatomy of the parts to be divided; whereas the more simple operations of amputation may be performed by any body, with little anatomical skill.

In the case of a musket-ball sticking in the condyle of the humerus, which from the softness of the bone at that part may easily occur, I would cut down upon it, and extract the ball with any splinters to be found, by applying even the trephine, if it could not be done under more easy circumstances, and, with a fair depending opening, wait the result.

In cases where the articulating surface of the condyles of the humerus are alone wounded, or the head of the radius and ulna are both destroyed, I would recommend the operation of sawing off the ends of the bones, as proposed by Moreau and Dr. Jeffray, where due attention can be paid, in preference to cutting off the arm. As there is no reason to doubt that the cases related are genuine, I am satisfied that accidents do occur in military surgery in which they are advisable, and frequently the accommodation and arrangement of hospitals will permit of every attention and sufficient comfort being given to the patient: besides, the arm is so manageable, that, if it fail, amputation will not be rendered impracticable. Before giving the methods proposed by these two gentlemen, I must caution military surgeons against performing them

unless they can isolate their patients, and put them in healthy situations, free from the confined air of any large hospital, however apparently healthy, or it is most probable the operation will fail, and be condemned from causes foreign to its nature. An injury to the head of the radius or ulna alone will not require so severe an operation; the pieces of bone should be removed, and the efforts of nature carefully awaited.

The following is Moreau's method, as performed in a case of carious joint of the elbow in the year 1797*.

"A table, about four feet high, was placed opposite a light window; on this a bed was spread, on which the patient was so placed upon his belly, that the diseased arm lay on the edge of the table, presenting to the operator the inner and posterior side of the joint.

"After having applied the tourniquet, on the upper part of the arm, to guard against the unnecessary loss of blood, as well as to deaden the sensibility of the parts to be operated upon, I entrusted it to an intelligent assistant. The arm being in a state of semiflexion, I plunged a dissecting scalpel in upon the sharp edge, or spine of the condyle of the os humeri, about two inches above its tuberosity; and, directed by the spine, I carried the incision down to the joint. I did the same on the other side. I then laid the two wounds into one by a transverse incision, which cut through the skin and the tendon of the triceps extensor cubiti, immediately above the olecranon.

"By these means I got a rectangular flap, one end of which adhered to the flesh, on the posterior side of the arm. This flap I raised from the bone, dissecting it from below upward; and I caused an assistant to hold it up, out of the way.

"The posterior surface of the os humeri being now bare, I washed it and wiped it with a sponge, in order to satisfy

* See Park, Moreau, and Jeffray, on Carious Joints, edited by the latter.

myself respecting the condition it was in. It was enlarged and rough: the joint was filled with purulent matter, and contained a fungous substance that occupied the place of the cartilages, which had entirely disappeared. No doubt remained respecting the propriety of removing this part; but wishing to be certain whether the caries had penetrated into the whole of its substance, I pared a little of it away with a gouge. This trial fixed my resolution. I then separated the flesh which adhered to the anterior side of the bone above the condyles, taking the precaution to guide the point of my instrument with the fore-finger of my left hand; and after I could pass the handle of a scalpel through between the flesh and the bone, I allowed the scalpel to remain there, and sawed the bone through upon it. I finished the removal of the piece by raising and detaching it from all its adhesions. Perceiving that the bone was diseased higher up, I was obliged to take away six or eight lines more.

"The most difficult part of the operation yet remained, for I had to remove the upper ends of both the bones of the fore-arm.

"My first flap being no longer sufficient, it became necessary to make another. I extended the lateral incision, at the outer side of the arm, carrying it downwards, along the external border of the upper part of the radius. I separated the head of the radius from the surrounding parts: I destroyed its connection with the ulna; and I introduced a strap of linen between them, to draw back the flesh from being injured by the saw. I cut the radius across, close by the attachment of the biceps, which I had the good fortune to preserve. Finding that some medullary cells, filled with pus, remained, I removed them with a gouge, without injuring the solid bone by which they were surrounded*.

* The bones of the fore-arm must be cut with a small saw. The flesh comes too much in the way of a large saw. The small one is difficult to manage; but what better can we do? And when you add to this the risk of cutting the vessels, which at this place pass through

" I next laid the ulna bare, by continuing the lateral incision of the inner side of the arm, which, with that I had made, gave me a rectangular flap, that adhered by its base to the flesh on the back part of the fore-arm. I detached it from that part of the bone which I wished to remove. I separated the bone from every thing that adhered to it; and having put a strap of linen around it, to protect the flesh, I sawed off about an inch and a half of bone, measuring from the tip of the olecranon downwards. The rest of the bone being sound, a few medullary cells excepted, I took them away, in the same manner as I had done those of the radius.

" It may easily be conceived, that the wound produced by this operation was enormous. It will be seen in the sequel, that it healed as soon as if it had been only a common wound. It was washed; the tourniquet was slackened; two or three small vessels sprang, which I secured by ligature. I brought the two flaps together, and secured them by two stitches of the interrupted suture. I put in two more, into each of the longitudinal wounds; one into the flap of the arm, and another into the flap of the fore-arm, on each side. That done, my patient was carried to bed, where a cushion of chaff, covered with several folds of cloth, and an eighteen-tailed bandage, were placed. On this the arm was laid, in a half-bent posture; and I covered the wounds with pledgets, dipped in a mixture of olive-oil and yolks of eggs, in order to prevent the lint from adhering, which renders the first dressing so painful. Over these pledgets lint was laid, and the whole was secured by compresses and a bandage. The weight of the bed-clothes was borne up by a hoop.

" The wound went on favourably: in fifteen days the arm was put in a sling, and the man walked about where he pleased. The wound healed, but the arm was at first powerless; by degrees it gained strength. In 1801, four years

the interosseous ligament, you will see how difficult this operation must be.

after the operation, the arm was less than the other, and three inches shorter. The bones of the fore-arm had grown together, but were not in contact with the humerus. The little finger had no feeling, from the ulnar nerve having been divided; but the man had the use of his arm so completely, as to be able to use it in thrashing in a barn, holding the plough, &c.*"

Dr. Jeffray of Glasgow, struck by the difficulty of sawing off the ends of the bone in this and other operations related by the same writer, invented a flexible saw, jointed on the principle of the chain of a watch, which certainly not only gives greater facility to this operation, but would be highly useful in other cases of military surgery, where the ends, or pieces of bone are to be cut off. He describes its operation as follows†:—

"Having brought the bone that is to be cut fairly into view, by an incision, the flesh is to be separated from it all round, and by the finger if possible. The needle, which it is scarcely necessary to say should be blunt at the point as well as on the edges, at the same time that it should be elastic, and adapted in curvature and size to the depth of the wound and the diameter of the bone, should then be taken in the right hand; and its point being brought to touch the surface of the bone on the right side, should be passed behind, and in contact with the bone, till, sweeping a half circle, it be felt or seen in contact with the bone at the other side, where it now may be laid hold of and drawn through.

"While the surgeon is thus employed in passing the needle behind the bone, his assistant should attend to the saw, by letting it through between his finger and thumb, so that its cutting edge shall be towards the bone. The saw being brought through, the needle is to be removed, and the

* See page 109 of Park, Moreau, and Jeffray, on Carious Joints.

† It may be seen at Messrs. Everill and Mason's, St. James's Street.

handles hooked on. The surgeon should now place himself in a position to have the full use of all the muscles of his arms; and having tried the saw gently, to see that its side is not to the bone, he should draw one end of it towards him smartly with one hand, and then the other with the other, till it cut the bone through; during which operation, the assistant should hold one end only of the bone fixed, for, if they press upon both, they will lock the saw, and retard the operation. The execution of the saw will be found to exceed expectation, for, as it is applied round one half of the bone, its cut is extensive. When, however, the bone is sawed nearly through the surgeon should either keep his hands farther separated from one another, than he found it necessary to do at the beginning, or he should give one handle of the instrument to an assistant, and retain the other himself, that they may stretch out the saw, and thereby make it more like a straight saw, as it approaches the anterior surface of the bone, lest, being then bent too sharp, it break; of which, however, if the force exerted be not unnecessarily great, I can say there will be very little danger, having now used, and sometimes roughly, the same saw for these fifteen years past, without either sharping or mending*."

Moreau, in his operation above described, divided the triceps extensor of the arm immediately above the olecranon, from which circumstance the extension of the arm was in a great measure lost: to obviate this inconvenience, Dr. Jeffray thinks his chain-saw peculiarly applicable. He says, p. 190, "recollect then the relative situation of the different parts about the joint; and you will find, that, by making two longitudinal incisions only, one on each side, and of sufficient length, as practised by Moreau, the chain-saw can be entered at the wound on one side, and be conducted by the needle across and in contact with the upper side of the bone, to the wound

* See Dr. Jeffray, page 176, 178.

on the other; and from whence it can be brought back, under the bone, with equal safety and ease. You have seen the saw applied in this way, to the bones below the joint, as well as to those above: and though the swelling of the parts must render every step of the operation more difficult in real practice than on the sound limb of a dead subject; yet I persuade myself you are convinced, from what you have seen, that however necessary it may be to lay the two lateral incisions into one, by a transverse cut, before the straight saw can be applied, few cases will occur requiring a transverse incision, if the chain-saw be used." To avoid the division of the ulnar nerve, he recommends the external lateral incision being made exactly in the course of the nerve, which is then to be dissected from its attachments, and drawn to one side or the other, as may be most convenient *.

In recommending this operation occasionally to be performed, I wish it again to be understood as requiring considerable precaution and attention, more so than the excision of the head of the humerus; for injuries of the joint of the elbow less frequently do well after gun-shot wounds than of the shoulder; and if every precaution cannot be taken, it is better to amputate at first, than, after a severe operation, and considerable suffering, to be obliged to execute it to great disadvantage.

The following cases of excision of the elbow and knee joint I have just received from Mr. Crampton†, and have great pleasure in introducing them.

"Alexander Gordon, 90th regiment, aged 23, was admitted into the Royal Infirmary, Phœnix Park, Dublin, on the 2d of January, 1823. To avoid the description of appearances, with which every medical man is but too familiar, it may perhaps be sufficient to state, that it would be difficult to find an

* See Dr. Jeffray, page 206.

† Cases of the Excision of Carious Joints, by P. Crampton, F.R.S. Surgeon-general to the Forces in Ireland. 1827.

individual in whom the 'scrofulous aspect' was more distinctly marked. He was sent to the General Hospital on account of true scrofulous white swelling of the right elbow joint. The disease was of about ten months' standing; the swelling extended at least a hand's breadth above and below the joint; suppuration had taken place over the inner condyle of the humerus, and the opening had degenerated into a large and irregular ulcer, at the bottom of which the bone could be felt in a state of caries. The man's general health was much impaired, his pulse was 120, and feeble; he had night perspirations, and, in a word, was far advanced in hectic fever. It was determined, in consultation, that the only chance of preserving his life was by sacrificing the limb, and he was sent into the General Hospital, in order that the operation might be performed. I thought this was a fair case for performing Mr. Park's operation, and having obtained the man's consent (who declared 'that he would willingly suffer any pain or risk for the chance of saving his right arm'), the operation was performed on the 4th of February, in the presence of the greater number of the principal surgeons, both civil and military, of Dublin. The patient was placed (as recommended by M. Moreau) upon his belly on a table covered with a mattress, and pillows so arranged as to make his posture as little inconvenient as possible: the diseased arm hung over the edge of the table, presenting its posterior and inner surface to the operator. The brachial artery being compressed by an assistant, an incision was now made along the spine of the inner condyle, commencing about four inches above, and terminating about two inches below its tuberosity. This incision passed through the centre of the ulceration, and laid bare the ulnar nerve, which was carefully raised from its groove, and drawn to the inner side of the incision*. A similar incision, parallel to the first, was made on the outer

* "From neglecting this precaution in M. Moreau's case, the ulnar nerve was cut across, and the ring and little finger were deprived of the powers of motion.

side of the humerus, and then a transverse section, which cut through the tendon of the triceps muscle, immediately above its insertion into the olecranon, connected the two longitudinal incisions, so that the wound represented pretty accurately the letter H; the lateral incisions, however, being slightly incurvated, so as to follow the bend which the fore-arm made with the arm. The upper flap, consisting of the lower extremity of the triceps muscle, the thickened and diseased cellular substance, and integuments, was raised from the flat surface of the humerus, to which it had a very slight attachment. The lower flap was separated in the same manner, so as to lay bare the upper extremity of the ulna and radius. The scalpel laid on its flat was now pushed between the flexor muscles and the bone on its anterior surface, at the distance of three inches above the tuberosity of the inner condyle, and retained in this situation by an assistant. The saw was then applied, and the bone was divided immediately over the flat surface of the knife, which served as a protection to the muscles beneath. The separated portion of the humerus was now raised with the utmost ease by the finger and thumb of the left hand, while the capsular and lateral ligaments, degenerated to the state of a lax cellular substance, were separated by running the knife round the condyles, keeping the edge as closely as possible to the bone. The lower extremity of the humerus being removed, the articulating surfaces of the radius and ulna were completely exposed; but, with the exception of the cartilage which covers the olecranon (which was partially eroded), every thing appeared sound. The olecranon was now removed, and the wound was spunged out. As there was no bleeding which rendered it necessary to have recourse to a ligature, the flaps were laid down, and secured to each other by four points of suture. The fore-arm was placed at a right angle with the arm; the wound was covered with pledgets of lint wetted with spirits and water, and the man was laid in bed, with the arm supported on a suitable pillow.

"He passed the night remarkably well. Suppuration,

attended with a very slight degree of symptomatic fever, set in on the fourth day; but, so favourably did every thing proceed, that on the ninth day he sat up in his chair, the arm being supported in a tin case, which I had constructed for the purpose. The wound, however, was slow in healing, no doubt from the bad constitution of the patient; I sent him therefore to the sea side five weeks after the operation, and there he recovered so rapidly, that on the following week he walked into town to see me, a distance of nearly five miles. He continued to reside at the sea side for three months, walking into town and returning on the same day once a week. On the 18th of September he returned to the King's Infirmary, in order to pass the board of general officers at the Royal Hospital for his discharge. At this time the wound, with the exception of a small superficial ulceration about the place which had been occupied by the inner condyle, was completely closed; the arm, when allowed to hang by the side, retained nearly a semiflexed position, but by a voluntary effort he was able to give a slight degree of flexion to the fore-arm, so as to lessen the angle which it formed with the arm. He had the use of the fingers, so as to be able to use his knife and spoon; and on the 27th of November 1823, *he signed his own discharge with the right hand.* While waiting in the hospital for a party, with which he meant to march to his native county in the north of Ireland, a large abscess began to form on the loins. Before he left the house it had acquired the size of a twopenny loaf; he marched, however, with the party, and I have heard nothing of him since that time. It is scarcely necessary to observe, that the occurrence of a scrofulous abscess in the loins could have no sort of connection with the operation; and that so far from throwing any discredit upon it, it seems to show, that, even in a constitution so decidedly bad, the operation may be performed with safety and advantage.

" The success which attended this operation naturally led me to extend it to a case of greater difficulty; accordingly,

on the 7th of May 1823, I performed the operation of removing the knee-joint in the case of Susan Conolly, a patient in the County of Dublin Infirmary.

" The particulars of this case are extracted from the hospital book, into which it was entered by the resident pupil.

" Susan Conolly, æt. 23, of a strumous habit and emaciated appearance, marked by several scars of scrofulous ulceration, some of which are still open on the left hand and arm. The right knee is considerably enlarged, of an irregular shape, projecting much to the inner side over the head of the tibia, and measuring three inches and a half more than the sound knee; the surface smooth, white, and shining, but marked by the ramifications of large blue veins. Severe pain, much increased by pressure, or by the slightest motion, is felt through the joint: a small ulceration under the inner hamstring discharges a great deal of thin, greenish-coloured matter; the joint is permanently contracted, the leg forming a very acute angle with the thigh; pulse 96, and feeble; skin rather hot; tongue white with red edges; appetite bad; tendency to diarrhœa; gets but little rest, from the pain of the limb; catamenia not present for the last two years. Disease commenced about twelve months ago; but the contraction of the joint, the severe pain, and the alteration of her health are but of six months' standing. The usual treatment had been adopted, but without even temporary relief; for the last six weeks she has had regular attacks of hectic fever, accompanied with profuse perspirations and diarrhœa, which even opium does not control.

" Having stated to my colleagues the grounds on which I proposed to substitute excision of the joint, in this case, for amputation, and obtained their concurrence, I proceeded to perform the operation in the following manner. An incision, commencing about three inches above the outer condyle, and a little below the axis of the femur, was continued to about an inch below the head of the fibula. The acute angle, which the leg formed with the thigh, necessarily gave to this

incision the form of a crescent. In making the incision the knife was carried down to the bone: a similar incision was made on the inner side of the joint. The lateral incisions were united by a transverse cut carried below the patella. The flap, thus formed, was raised by a rapid dissection, and the cavity of the joint was completely exposed: for the extent of more than three inches above the condyles the femur was without periosteum, the purulent matter lying in contact with the naked bone. At the point where the periosteum appeared to be united with the bone the saw was applied and the bone was divided, the soft parts being protected by a spatula which was passed between the muscles and the bone. The separated portion of the femur was now dissected out, and so slight were its connections with the soft parts, that this part of the operation, which I expected would have been attended with some difficulty, was effected with the greatest ease. The articulating surface of the tibia was now fully exposed: it was totally deprived of cartilage, and was in a state of caries. By means of a strong and short knife, such as is used by shoemakers, I was enabled to pare away about half an inch of the head of the tibia, the cancelli of which were loaded with a lardaceous matter, and with pus.

"The cavity of this great wound was now sponged out, when, upon minutely examining the cut surface of the femur, I found that the cancelli were diseased and filled with pus, and that posteriorly the periosteum was detached from the bone. I therefore sawed off about an inch and a quarter more of the femur. On placing the extremities of the femur and tibia in contact, the flap, containing the patella, was found to be about three inches too long; and as the patella itself was totally deprived of its cartilage, and in a state of caries, the exceeding portion of the flap, including the patella, was removed by a transverse incision. No artery was divided which required the application of a ligature. The flap was retained in its position by two points of the interrupted suture, and compresses wetted in spirits and water were laid over the

wound. The limb was now placed in position in one of Assallini's 'carrying splints,' which had previously been carefully adapted to the size and length of the limb, it extended from above the trochanter major on the outside, and from the ramus of the pubis on the inside to about four inches below the foot; it was supplied with a sole piece, which supported the foot, and was carefully padded with a mixture of baked hair and wool.

"The woman bore the operation, which was by no means tedious, with great fortitude; and indeed, when it is considered that very little muscular structure, and no large nerves or blood-vessels were divided, it is probable that the pain was much less than is attendant upon an amputation of the thigh. However this may be, it is certain that the operation was succeeded by but little constitutional disturbance; and, to the great surprise of every one who witnessed the progress of the case, this great wound united by the first intention, and was healed in less than three weeks. The patient's health continued to amend rapidly until the 12th of September, when she had a rigor which ushered in an attack of erysipelas, that affected the leg and thigh. I may observe (in passing), that erysipelas was, at that time, prevalent to an unusual degree in the Meath Hospital, and in all the hospitals in Dublin. The erysipelas, however, was succeeded by abscess, which burst through the old sinus in the ham, and continued to discharge for three or four weeks, and then healed. The woman's health, which had greatly declined during the formation of this abscess, began to amend as soon as it had ceased to discharge; and in the month of November she was able to go about the hospital, the limb being supported by a splint, so constructed that the weight of the body was thrown on the tuberosity of the ischium. No degree of union, however, had taken place between the bones; and while she remained in hospital she suffered two or three attacks of erysipelas, much slighter however than the first, but each of which terminated in the formation of matter, which escaped,

either through the old sinus, or through a small aperture which was formed in the anterior and upper part of the cicatrix. She was discharged from the hospital on the 27th of June 1824, in very good health, but no bony union had taken place between the femur and tibia. In the winter of 1825-6, hearing that her health had very much declined, and that she was living in great poverty, in a damp cabin in the country, I had her brought up to town, and she was readmitted into the hospital.

She was now in a wretched state of health; she had suffered repeated attacks of hæmoptoe, and had cough, with purulent expectoration and night sweats. She had no pain in the limb, but there was a general thickening about the joint, as if the disease had been reproduced, and the sinus in the ham continued to discharge a thin whey-coloured matter. By suitable attention her health again rallied, and she returned to the country in the month of May 1826. Shortly after her return I was informed that her health again declined, and that she died some time in the month of July 1826, just three years and two months after the operation.

"I would just observe, that were I to repeat the operation of excision of the knee-joint, I should adopt a different mode of operating from that which I employed in the cases of Conolly and Lynch.

"I am satisfied, from repeated trials upon the dead subject, that the operation can be most safely and rapidly executed by separating the condyles from all their attachments, previously to sawing the bone; as soon, therefore, as the flap containing the patella is turned upwards, the edge of the knife should be carried round the condyles, close to the bone, so as to divide *all* the ligaments which connect the femur with the tibia; the tibia can then with great ease be pushed backwards, and as much of the projecting condyles can be removed as the operator may think necessary."

Amputation of the Fore-Arm.

Wounds of this part are frequently more serious in their results than their appearance at first gives reason to suspect; and the operation of amputation becomes in general a secondary, rather than a primary one, from the subsequent evils demanding it; and the principal one arises from the constitution becoming affected, so as in time to endanger life. For, although the fore-arm is liable to more complicated injuries than the upper arm, still it is quite under our management. The two bones can be more easily got at, and pieces extracted with ease; the arteries, particularly the radial and ulnar, can be cut down upon, and, except at the upper part, secured without any difficulty. The interosseal, ulnar, and radial arteries can and ought to be fairly tied whenever they bleed, at any sacrifice of muscular parts; and the fascia may be divided freely in every direction, as it may be found to impede the discharge of matter, or cause other inconvenience to the patient. An advantage arises also from the number of the arteries supplying the lower part of the limb, for if one be wounded, another, and perhaps two, remain to support and nourish the parts below, which, from the free communication of the palmar arches, is readily effected; mortification of the fingers therefore seldom or never takes place, from wounds of the fore-arm.

These observations will show that amputation is seldom considered necessary after wounds from musket-balls. A fracture of both bones of the arm, with a division of the arteries, is, perhaps, the only case from a wound by a musket-ball, in which it may be legitimately performed as a primary operation; a wound of one artery with fracture of both bones is not sufficient, as the artery should be fairly tied at both extremities as soon as the injury be ascertained, and which perhaps may even be only suspected from the want of pulsation at the wrist.

If both the radial and ulnar arteries be wounded by a raking

musket shot, it may, under certain circumstances of great extent of injury, as a ball passing from the wrist to the inside of the elbow-joint, be necessary to amputate. I would recommend in most cases, in the first instance, both vessels being secured at each end by regular incisions for the purpose, and the arm only removed if gangrene supervened. The stuffing of the fore-arm with blood, in consequence of the wound of the vessels, without fracture, is not a sufficient cause for amputation, as relief can be obtained by free incisions.

Cannon-shot seldom strike the fore-arm without doing such injury as demands amputation, if they do not carry it away; arising, I conceive, from the two bones being so near the outline of the arm for two-thirds of its length, and allowing of no recession from the elasticity of parts before the impulse of the ball. From the firmness with which the parts are bound together, there is, in general, a greater laceration, which with fracture even of one bone may render the operation advisable. If the muscles composing the thick part of the arm only be carried away, even with division of one or more vessels, the operation is not imperiously called for, until other circumstances arise which may render it necessary.

When the hand is carried away below, or at the joint of the wrist, the operation is required instead of attempting to cover the end of the radius and ulna, or preserving one range of carpal bones.

A wound of the carpal end of the ulna opening into the joint of the wrist does not demand amputation, for the ulna enters so little into this joint, that with due care it may be expected to do well with some little loss of motion. The destruction of the radius is of more consequence, and if the joint of the carpus be opened, and the radius, the scaphoides, and lunare, also destroyed, the operation is generally requisite. If the ulna and radius be both injured, in the same manner, it is necessary as a primary operation.

Wounds, by musket-shot, of the lower range of bones of the carpus, do not require amputation. I have seen numbers

of them do well and recover, with some little loss of motion of the wrist, and of the fingers to which the tendons that may be divided were going; but even this is in some measure removed in time, by the connection there is between all the flexor and extensor tendons of the hand.

The operation being determined upon, a question has arisen, at what part it should be performed; and here the practice of some of the English and French surgeons differs materially.

There are two places of general election, one near the joint of the wrist, in the lower third; the other near the elbow, in the upper third of the arm: the one performed in muscular, the other in tendinous parts. And this difference of substance causes the difference of opinion in question.

It has been already stated, when treating of "Amputation," that many, indeed a great part, of the French surgeons do not endeavour to effect union by the first intention, but gradually cause the parts to approach each other by means of bandaging; they then place some lint on the incised muscles and integuments, and wait for suppuration, granulation, and the subsequent approximation and adherence of the wound.

The British surgeons, on the contrary, lay down the parts after every amputation, and endeavour to unite them.

The French surgeons, and particularly Baron Larrey, declare, that amputation at the lower part of the wrist does not succeed; and recommend that the operation should be performed in the fleshy part above; and this not only when the injury has been inflicted by cannon, but by musket or grape shot, and without reference to the apparent soundness of the part. They support their opinion by the result of their practice, which they state to be unfavourable to the lower operation, and generally attended with disease of the bone, formations of matter, and other evils that frequently render another operation advisable, or at least leave the stump, in many instances,

painful and useless. The reason for this is supposed, by them, to arise from the aponeuroses of the muscles, the fascia binding down the tendons and the periosteum of the bone, being torn up to a greater distance than is generally conceived; in consequence of which, matter is formed amongst the tendons, or caries of the bone takes place to a considerable extent, or there are large exfoliations with a tedious cure; all of which they say they avoid by cutting higher up in the thick part of the fore-arm.

I admit that accidents of this kind may occasionally happen, but the surgeon can in general judge with sufficient certainty whether they have occurred or not; and no one would perform the operation from choice, if he considered the periosteum to be separated, or even slit up from the bone, above where he intended to saw it off, or the fascia torn to any considerable extent. But I cannot coincide in the opinion that these accidents occur frequently; or, if they do occur, that they are so detrimental under proper treatment; for my own experience, and that of the medical department of the British army, is in direct opposition to that of the French surgeons. As the nature of wounds must be the same in both armies, the difference of success must be looked for in the mode of treatment, and here I think it will be found. The British surgeons bring the flaps together, cover the bones and ends of the divided tendons, and endeavour to obtain as much union as possible by the first intention. The French, on the contrary, do not lay the parts down in contact; they are merely approximated by drawing the integuments and muscles forward, and suppuration is awaited. This I conceive to be the error; for, however valuable this mode of proceeding may be under certain circumstances, it is here detrimental. There is but little muscle to granulate, the greater part is tendon and cellular substance: tendons will unite to each other, or to fresh incised parts, but they will not granulate, and in the attempt to attain it, the bone becomes uncovered, the periosteum re-

cedes from its edge, and it will then exfoliate: if abscesses form near it from the disease of the tendons or periosteum, caries may ensue for a considerable distance, and the train of evils usually attendant on the flat stumps of the more ancient surgeons. This I consider to be the real cause of the ill success of the French surgeons; and whenever they will lay down the flaps in apposition in fair cases for the operation, I am confident they will succeed in the same manner as we have done in the British army.

I must dissent from the opinion that a short stump is as good as a long one, for I have seen the most decided utility from the latter; and perhaps the relation of the following cases will best exemplify the value of the operation, both as to its safety and use.

Two private soldiers in America, supposing they would be discharged the service, placed their left hands on the muzzles of their firelocks, and destroyed the joints of the wrist, fracturing the articulating extremities of the radius and ulna. I took off the arm of each at its lower third, by the flap operation, hereafter to be described, and in three weeks they were both well, and able to do the duty of necessary-cleaners to the whole regiment, which they were ordered to perform as a mark of ignominious punishment. On the landing of the British army in Portugal, in 1808, their usual duty having of course ceased, these two fellows were attached to me as bâtmen, to load and take care of the public mule, with the medicines and instruments committed to the charge of the surgeon: this they did extremely well, lifting with a hook fastened to the cuff of the coat of the left arm very great weights, supporting them also above their heads on the face of the naked stump, whilst they tied the ropes that retained them with the right hand. They would even press the girth forcibly against the belly of the mule with the stump, whilst they buckled the saddle with their remaining hand; a proof that the stump was as sound and as well covered as it was possible

any thing could be, by the art of surgery. In fine, I can with truth assert, I never saw the operation fail when executed in the following manner, and it ought not to be done in any other.

The arm being placed in the intermediate position between pronation and supination, with the thumb, if it remain, uppermost, so that the radius and ulna are in one line, and firmly held by an assistant; a catlin (two inches longer than the usual size, if it can be procured) is to be entered close to the inner edge of the radius, and brought out perpendicularly below at the inner edge of the ulna: the knife is to be carried forward on a parallel line with the bones for half an inch, and then made to cut its way out with a gentle inclination, so as to leave a semicircular flap. The catlin is to be again introduced on the outside, at the same wound, and pushed out below in the same manner, the end of the knife being brought out at the wound made by the first incision, which is easily accomplished, as the point of it passes the ulna by turning the arm a little inwards. These two flaps are to be turned back equally to the point of entrance of the knife, where the interosseal ligament and any muscles or tendons not cut by the incisions for the flaps are to be divided; the bones are then to be cleared, the retractor run between them, the flaps kept back, and the two bones sawed across at the same time. The radial and ulnar arteries will be found on the inner flap, and as by the inclined cut of the flap they may be wounded by the edge of the knife higher than where they are absolutely divided, it is advisable to tie them high, and cut off with the scissors any long portion that may be below the ligature. The tourniquet may now be loosened or taken off, when the interosseal artery will show itself between the bones on the inside, and perhaps another on the outside. If the tendons hang long they are to be cut off with the scissors. The wound being thoroughly sponged with cold water, the two flaps are to be placed exactly in contact: some straps of adhesive plaister, a slight compress, and a few turns

of a roller, retain them in their situation, and in a very short time, frequently a fortnight, the cure is accomplished.

When the operation is to be performed above the middle of the arm, it is best done by the circular incision, as follows.

The arm being placed with the thumb uppermost, an assistant must retract the integuments as much as possible, whilst the operator makes one circular incision through them, which must be then fairly pulled up or separated from the fascia below for nearly an inch. The edge of the knife being inclined inwards, the muscles on the inside of the arm should be divided at one slanting cut down to the bones; the same on the outside and upper part. The bone is then to be cleared by separating the muscles from it, until it is obvious they will meet over it when sawed. The interosseal ligament is next to be divided with the catlin, and the retractor passed between the bones, by which the integuments and muscles are to be well kept back, and the bones then sawed through at once, and the stump dressed as usual; or the operation may be performed nearly after the manner in which it was done lower down; or the lesser amputating knife may be used, by cutting obliquely from without inwards until the flaps shall be sufficiently large to meet with a thick cushion over the ends of the bones when sawed off: this method also makes a good stump, but I think the other preferable for young operators, as it will better cover any defects, or avoid the appearance of irregularity on the face of the stump.

Amputation of the Metacarpus and Fingers.

Gun-shot wounds of the hand are particularly disagreeable, in consequence of the tendency they have to bring on trismus, or locked-jaw; and to avoid this, in many instances, the hand has been removed, when it might otherwise have been in part saved. The difficulty attendant on the removal of the heads of the metacarpal bones from the joint of the carpus, or of saw-

ing off the bones with the metacarpal saw, has been another cause of the frequency of the operation above the wrist.

The advantage of two or three fingers, or of the thumb and two fingers, or even the fore-finger, is so great, that much ought to be attempted and hazarded to save them; and it is generally allowed that few wounds from musket-balls occur, in which amputation of the hand is necessary.

The tendency to tetanus or trismus is to be obviated in some measure by freely cutting up the palmar aponeurosis, removing all spiculæ of bone, and by keeping the wound open preventing the collection of any matter under the fascia, or expansion of the tendons. The fear of wounding the arteries ought not to be indulged; it is advisable to avoid them if possible, but this immunity should not be acquired at the hazard of causing a greater evil; for they are secured, if injured, with tolerable ease; and if the incisions be made in the direction of the bones and flexor tendons on the inside of the hand, when they are required on that side, no hæmorrhage can ensue, that may not be readily commanded by the ligature, or a small graduated compress.

A musket-ball passing fairly through the hand, generally fractures two of the metacarpal bones; it sometimes merely fractures them by passing between them, and I have seen a ball pass through between two bones without breaking either of them. Two are generally injured, one more than the other; but it is not necessary to amputate as a primary operation for this cause alone, whatever circumstances may render it necessary to do afterwards; on the contrary, the wounds should be enlarged, the broken pieces of bone removed, and the most vigorous antiphlogistic measures adopted.

When cannon-shot, splinters of shells, or grape-shot strike the hand, it is generally the reverse; amputation of one kind or other is necessary, but seldom of the whole hand. Either the thumb and fore-finger, with its metacarpal bone, or the two outermost fingers, or the two centre ones, are destroyed, and require amputation: or, both the flexor and extensor

tendons are cut across, and hanging out of the wound, the joint of the wrist is opened into, and the skin of the hand much torn; there is also in general considerable hæmorrhage, which continues to ooze, although the blood is not thrown out per saltum; the bones are found totally destroyed, and as the hand is frequently bent or closed, the fingers are often also wounded. Amputation is in this case to be performed as soon as possible, for the sooner the wound becomes a clean incised one, the better. When the metacarpal bones of the three outermost fingers are destroyed, the thumb and fore-finger are worth preserving.

The little finger is occasionally to be kept, when the two middle ones are sawed off, and in taking away the two outermost fingers, the next metacarpal bone is not to be removed, even if it be a little injured; the tearing up of the integuments is not of so much consequence as is believed, and in performing the operation of removing any two bones, flaps may frequently be procured, partly on one side, partly on the other, when a whole one cannot be obtained from either. The opening into the joint of the carpus will do well in most instances, if skin can be procured to cover the joint injured: in fact, the hand is so valuable, and is so much under the command of the surgeon, if attention be paid to it at first, that much ought to be hazarded to save it. The removal of the hand is also a last resource, after every attempt has failed.

The metacarpal bones and fingers may be removed in two ways, by sawing the bones across, or dislocating them from their articulation at the carpus. Both these operations have frequently been found extremely difficult and tedious; and it was in consequence of this, and the anguish suffered by the patient, that the removal of the whole has been occasionally practised in bad wounds of the hand.

The metacarpal saw is the only instrument given to military surgeons for the purpose of sawing these bones; and in consequence of the small size of the teeth, and the unsteadiness

of the bone, it becomes a most unpleasant operation. I have seen a surgeon work for twenty minutes at two metacarpal bones with this instrument, to the unspeakable torment of the patient, and his own serious annoyance.

This part of the operation may in some instances be materially shortened, and rendered less painful, by the adoption of one of Mr. Hey's convex saws, or of the crown of the trephine instead of a saw; and if one be chosen for the purpose, as recommended by Mr. C. Bell in his Operative Surgery, and by Mr. Wardrop in the 4th vol. of the Medico-Chirurgical Transactions, it will answer much better. The instrument is prepared by cutting away two-thirds of the head of a small trephine, so that the remaining third may form a saw, which, when the centre pin is fixed in the middle of the bone, will cut it through nearly in a straight line. When the bone is much shattered by the shot, and destroyed near to the joint of the carpus, it will often be impossible to find a part of the bone on which the pin can be fixed, so as to allow the saw to work: and the removal of the head of the bone will not be less difficult, if it be of a middle finger; and in a case of this kind, Mr. Hey's saw will be very useful. When the thumb is destroyed in this manner, it is much the easiest way to remove it at the joint of the first phalanx, corresponding to the metacarpal bones of the fingers with the wrist; the same with the little finger, or when the two outermost or even three outermost fingers are to be removed.—The metacarpal bone of the fore-finger should always be sawed off as long as possible when the thumb remains—and it is always advisable to do so with a middle finger, as it is very difficult to dislocate one bone between two others, whereas commencing from the outside, it is done with less trouble. The preserving the articulation inviolate especially supports the remaining fingers, and leaving a part of the metacarpal bone of the fore-finger is of great utility, in giving strength and a freer motion to the thumb.

As there is always a laceration in gun-shot wounds of the

hand, even from musket-balls, but more particularly from shells or shot, the incisions will not be very direct, or according to rule; and the skin torn up, must be considered as inclined to adhere when laid down, if it be not much bruised.

The first phalanx of the thumb requiring to be removed, an incision must be made on the back of the hand on the inside of the bone, commencing between the thumb and the finger, carried down to the joint of the carpus, and brought over with a gentle slope to the outside. A similar incision in the palm of the hand joins the point of this slope, and the muscles are to be divided close to the bone. The flap over the joint of the thumb, formed by the slope of the integuments, is to be pulled a little back, the external lateral ligament cut into, and the thumb bent and pressed a little inwards, when it will readily be separated by cutting through the capsular ligament, and any adherent ligamentous or muscular fibres; the compression on the brachial artery is to be taken off, the vessels tied with single threads, and the parts brought together with adhesive plaister and bandage.

In the removal of the two centre metacarpal bones near their middle, two transverse incisions are to be made on the back and palm of the hand, a little nearer the fingers than where they are to be sawed through, and these incisions are to be exactly the width of the two bones; the skin is to be dissected back to the place where the bones are to be sawed, and a longitudinal incision is then to be made on each side of the two bones to be taken away, between the fingers and into the palm of the hand, so as to join the transverse cut inside. Care is now to be taken that the tendons running to the fore and little fingers are not injured, as the soft parts belonging to the fingers to be removed are cut through; the saw or trephine is now to be applied and the bones cut across. The little flap saved on the upper and under part will cover the sawed bones, and the skin saved at the sides will cover the bones remaining with the help of a strap of adhesive plaister, so as to leave only a line of incision everywhere. If the na-

ture of the wound will not allow the flaps to be made from every side in this way, each flap may be taken from above or below, as circumstances will permit.

Removing the middle metacarpal bone alone, must be done nearly in the same manner, but with more care, so that the articulations of the adjacent fingers be as little injured as possible. It must be recollected that there is a wound through the hand, and that skin cannot be saved at will; it must, therefore, be kept either from the back part or inside, as will be most convenient, which, in almost every case in the hand, will somewhat vary the first incision.

If there were no wound through the hand, the best manner of removing the diseased bone would be by a circular incision round the root of the finger, and continued down the back of the hand, when the diseased bone is to be dissected out.

If the articulating heads must come out, a strong but thin scalpel is to be used, and pushed in between the bones, the ligaments being cut through above, below, and at the sides; care should be taken in the efforts to get out the heads of these bones, not to dislocate the other fingers, or to injure them as little as possible, and the cavity of the joint of the carpus should be covered by a flap or flaps, if they can be obtained.

The outer fingers are easily removed at the joints commencing from the outside, and when the ligaments on the inside are cut, dislocating them outwards.

The most satisfactory case of the hand I have ever had was of this kind, at the battle of Salamanca. The man had been struck by a grape-shot, which shattered the metacarpal bones of the little and ring finger, grazed the middle finger, and tore up the integuments on the palm and back of the hand. He was in great pain, and it was intended to remove the hand, when I conceived there was a probability of saving the two fingers, and the thumb, although no regular flaps could be made to cover in the wound. By cutting some parts on

the inside, others on the outside, I managed to cover in the joint of the carpus, replace the torn integuments on the back of the hand, and then waited for granulations to cover the exposed part of the metacarpal bone of the middle finger. At the end of two months he was cured, with the use of the thumb and fore finger, and considerable motion of the middle finger, and was very grateful for the attention paid to him.

The joints of the first phalanx of the fingers with the metacarpal bones may be removed by making a flap on the upper or under part; in either case making the edge of the flap the depending part by the position of the hand.

When the flap is made from the back of the finger, the bend of the joint should be ascertained; from this point an incision is to be made along each side of the finger for about an inch, in a semilunar form, and the angle of these two joined by a transverse incision underneath, when a flap can be raised of sufficient size to cover the wound after the bone has been removed. This flap being turned back, the extensor tendon divided, and the joint laid bare, a semicircular incision is to be made on the under part, so as to divide every thing down to the bone. The joint should now be a little bent to show its exact position, the ligamentous attachment between the bones, on each side connecting it to its fellow, cut through, and the lateral ligament divided, when the joint will be easily dislocated. Two small vessels will often require a single thread, sometimes even a pinch from the forceps will be sufficient to stop the hæmorrhage. The flap is to be brought down or raised up, according as it is formed from the fore or back part of the finger, and retained by adhesive plaister.

If skin to form the flap in this way cannot be saved, the operation may be done by a circular incision, or by two semilunar flaps on each side, but the former method is preferable: I have never found it necessary to remove the cartilage, and it renders the operation more painful.

If the flap unite by the first intention, it will not adhere to the cartilage, but slide over it for some time, a little fluid be-

ing interposed, which will gradually be absorbed, and the integuments become firm.

The other joints of the fingers are to be removed in the same manner, taking particular care to cut into the joint on the side, through the lateral ligament, by which it is firmly connected, when it may be readily dislocated, by moving it in an opposite direction.

It is generally best to remove these bones at the joints; but where the injury just includes the joint, and no more, it is proper to saw them off below it: this operation may be done by a circular incision; and the trephine, or the straight metacarpal saw, may be used; both are troublesome, but the metacarpal, or the fine straight saw, is the best, as there is room to steady the bone and space for its motion. The soft parts should be defended by a slip of pasteboard, placed between them and the teeth of the instrument, especially when the metacarpal or metatarsal bones are to be divided. A facility in sawing is sometimes acquired by turning the teeth of the saw inwards, towards the concavity of the handle, and passing the saw to the inside of the part to be removed. These operations, although apparently trifling, require as much practice on the dead body, and as much attention on the living, to perform them well, as others of far greater importance.

APPENDIX.

The following cases, by Mr. Boutflower, should have been printed in succession to those on the same subject, page 273; but were at the time mislaid. They are given in the form of an Appendix, from their being so strongly illustrative of the disease in question.

Owen Sweeney, 2d battalion, 90th regiment, æt. 19, was wounded by a musket ball, on the 18th June, which carried off a great portion of the little finger of the left hand, and wounded the ring-finger; the former was amputated at its metacarpal articulation, on the following day. Between the period of his quitting Brussels, July 5th, and his arrival at Colchester, on the 14th, a collection of matter had formed above the annular ligament of the carpus, which broke spontaneously and discharged freely; he had at this time a most unhealthy aspect; but his appetite was good, and he did not complain. Bark was prescribed for him, and a pint of porter allowed daily. On the 24th, a second collection of matter pointed about the middle of the back of the fore-arm, which was evacuated; and, on the 26th, a third, about an inch higher up, which was treated in like manner: the whole discharged good healthy pus, and his health rather improved. As he was not confined to bed, but walked a good deal about, there being many more severe cases, I only occasionally saw him. On the 29th, I was informed that in the preceding night there had been a hæmorrhage from the several abscesses, which, however, was soon suppressed; I found him looking extremely ill; the discharge very fetid, and mixed with blood. The limb was enveloped in cold compresses, and a tourniquet

applied loosely by way of security. Hæmorrhage recurring in the night, the arm was removed on the 30th. On dissection the whole of the muscles were found in a state of disease, the flexor ones particularly were entirely separated from their attachment to the bones; the integuments (with the exception of the parts where the abscesses had pointed) were perfectly sound. He continued extremely well after the operation till the afternoon of the following day (31st), when he was seized with rigors, which continued for about fifteen minutes, and were succeeded by febrile symptoms and a tendency to vomit. Effervescing draughts were prescribed. On the following morning he was considerably better, and continued going on perfectly well till the 6th of August, when he was again attacked with symptoms of fever. Nothing could possibly be more favourable than his stump at this period. Small doses of the sulphat of magnesia were ordered him. Early in the morning of the 7th he was attacked with griping of the bowels, followed by purging and vomiting; it was many hours before the latter could be overcome, and he was very much reduced by it. A cordial mixture was prescribed; the vomiting returned, at various intervals, till the evening of the 8th. Small quantities of wine and tinct. opii appeared to agree with him better than any thing else, and a blister applied to the scrobiculus cordis seemed to give relief. On the 9th he was very low, and complained of pain and tenderness on pressure of the abdomen, which was in some degree relieved by fomentations and an enema; his stump continued to look extremely well, and discharged healthy pus, in small quantity; the ligature on the brachial artery, which had been cut short, came away this day. On the 10th, the fulness and tension of the abdomen had returned, and not having had an evacuation since the preceding day, the enema was directed to be repeated. His tongue and teeth were covered with a dark sordes; chicken-broth and wine were ordered to be frequently given him, in small quantities. The adhesions that had taken place appeared this day disposed to separate. During the night of

the 10th he was very restless, and had low delirium; and on visiting him, on the morning of the 11th, I found him collected, but very low, and with the complete facies hippocratica; two injections had failed to procure a motion, and he was ordered a pill composed of hyd. submur. gr. iij, opii gr. ss. which he swallowed with some difficulty: he continued to take small quantities of wine till one o'clock, when he died.

Appearances on Dissection.

On raising the sternum, the pleura of the left lung (the affected side) was found to have formed strong adhesions to that of the ribs, both of which were covered with a thick layer of coagulable lymph; the lung itself was highly inflamed, and on cutting into its substance a number of small tubercles were observed; the right lung was entirely free from disease; the pericardium contained a more than usual quantity of fluid, as did also the left cavity of the thorax.

It is worthy of remark, that, during the progress of this case, no one symptom whatever existed that could induce a suspicion of inflammation going on in the thorax.

Thomas Haynes, 23d light dragoons, æt. 19, was wounded on the 18th of June, by a spear, on the back of the left forearm, about a hand's width above the wrist. It did well until the period of his departure from Brussels: on his march from that place to Ostend it assumed an unfavourable appearance, and on his arrival at Colchester, on the 14th of July, it was completely in a sloughing state. I first saw him on the 16th; the sore was then circular, and about three inches in diameter; the integuments were entirely destroyed, and the whole of the extensor muscles were deeply involved in the disease; he had considerable fever, accompanied with a strong hard pulse. Attention to the state of the bowels had been the only constitutional treatment employed; the local applications consisted of emollient poultices only. The pain was excessive, and the tenderness around the whole circumference of the

sore was so great, that he could not suffer the smallest pressure with the finger. I directed him to be largely bled, and, instead of the poultices, a solution of the sulphuric acid, ʒj to ʒxij, to be applied twice a day to the whole surface; to allay the burning heat that constantly prevailed in the surrounding parts, he was directed to keep them continually wet with cold water: that treatment was pursued till the 21st, during which period he was bled five times, and the quantity of blood drawn each time amounted to about twenty ounces. His bowels were kept open by saline purgatives, and he drank plentifully of acid drinks. The sore had not increased in size; several portions of sloughs had been detached, leaving healthy granulations: there was still, however, much to be thrown off; the strength of the solution was directed to be increased from ʒj to ℥j; care was taken in the application, that the sloughing portions only were touched with it; his health was considerably amended, and on the whole a favourable result was expected.

About two o'clock on the morning of the 22d, a sudden and unexpected hæmorrhage took place; it was most profuse, amounting, I should consider, at least to three pints. I found him at my hour of visit with his countenance extremely pallid, and pulse very frequent and weak; sore continuing to improve. It was difficult to pronounce with certainty from whence the bleeding came; the extent of disease rendering it possible that it might be from any of the great vessels of the fore-arm. The same treatment was directed to be pursued, and a loose tourniquet was applied to the limb, by way of security. A second hæmorrhage ensued on the morning of the 23d, which was immediately suppressed. Notwithstanding the patient was very low, I amputated the arm: scarcely a drop of blood was lost during the operation.

The pulse continued quick: in other respects he was perfectly well until the 25th, when he had some accession of fever, for which a saline purgative was prescribed; on visiting him in the evening of the same day, I found that

the cathartic had operated briskly; notwithstanding, his fever had increased and his pulse was become fuller and harder; in consequence of which he was bled to the amount of ten ounces. On the following day he had somewhat less fever, but his pulse remained very frequent; haust. salin. effervescens, 3tia qq. horâ. The outer dressing and a portion of the straps were removed; adhesion by the first intention appeared to have taken place nearly through the whole extent of the stump. On the 27th he remained much the same, and had no unpleasant symptom, with the exception of the frequent pulse, which now beat 140 strokes in the minute; he was free from pain of every kind. On removing the centre strap, which had been suffered to remain yesterday, a large collection of matter (of good quality) issued. Capiat ter die tinct. digitalis gtt. x, in haustu salin. effervescente. On the 28th the frequency of the pulse was not diminished, but it was less full than the preceding day; no other untoward symptom as yet manifested itself; from the centre of the stump (the only part where adhesions had not taken place) a similar quantity of healthy pus was again discharged. In the evening he remained much the same; but having had no motion for twenty-fours, a common purgative injection was prescribed. On visiting him the morning of the 29th, I was instantly struck with the alteration in his countenance, which had assumed a deathlike paleness; his pulse was less frequent (120), but intermitted about every fifth pulsation; his breathing very short and laborious, with some pain in the chest, and every symptom of effusion having taken place; stump continued to discharge good matter, but much less in quantity — ℞. carbon. ammoniæ gr. x, confect. aromat. ℥j. M. ft. bol. 4tis horis sumendus. He got rapidly worse, and died at two o'clock P. M.

Appearances on Dissection.

The only morbid appearance that presented itself was a large quantity of serous fluid in the pericardium and in both

sides of the thorax: the former was perfectly distended with it. The heart and lungs, with their membranes, were quite sound.

On examining the stump, it was found that the sanative process had been entirely confined to the integuments; no appearance of granulation could be perceived on the muscular surface.

It should have been stated, that on examining the arm after amputation, the bleeding was found to have proceeded from the radial artery, which had sloughed about its centre.

Fig. 1.

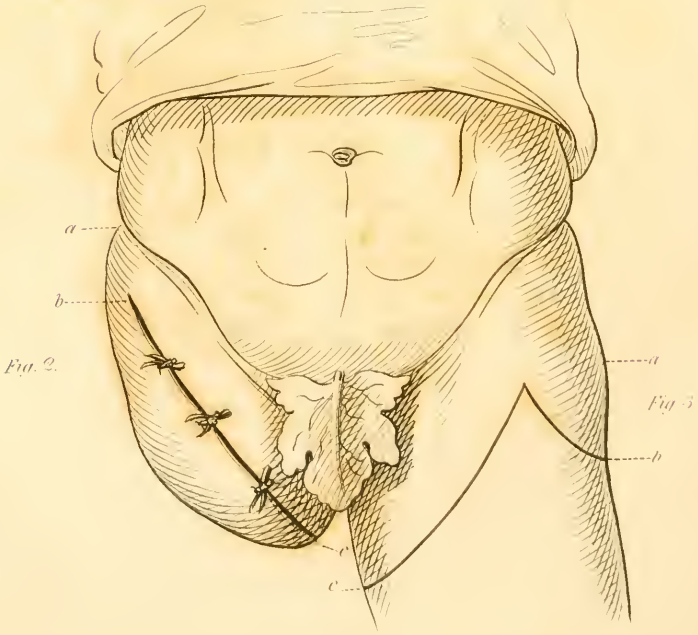


Fig. 2.

Fig. 3

EXPLANATION OF THE PLATES.

PLATE I.

Fig. 1. Shows the line of incision recommended in the operation of amputation at the hip-joint, described at page 363.

a. The anterior superior spinous process of the ilium.

b. The first incision, commencing about four fingers' breadth, and in a direct line below the anterior superior spinous process of the ilium in a well-proportioned man, and continued round, in a slanting direction, at an almost equal distance from the tuberosity of the ischium, nearly opposite to the place where the incision commenced.

c. The second incision, commencing underneath, where the former ended, and united by a gently curved line to it at the place of its commencement, by which means the outer incision is not one-third of the size of the internal one.

Fig. 2. The wound made after the removal of the bone, and united by sutures: sometimes the line of union is more horizontal.

a. The anterior superior spinous process of the ilium.

b. The commencement of the line of incision, which runs down to *c*, or the tuberosity of the ischium.

Fig. 3. Shows the line of incision recommended in the flap operation high in the thigh, described at page 383.

a. The trochanter major.

b. The outer incision.

c. The inner incision.

PLATE II.

Fig. 1. Shows the appearance of the hip in François de Gay, on whom the successful operation of amputation at the hip-joint was performed by the author, as described page 342.

a. The cicatrix caused by the operation.

b. The shot-hole and cicatrix, caused by an additional opening made for the discharge of matter.

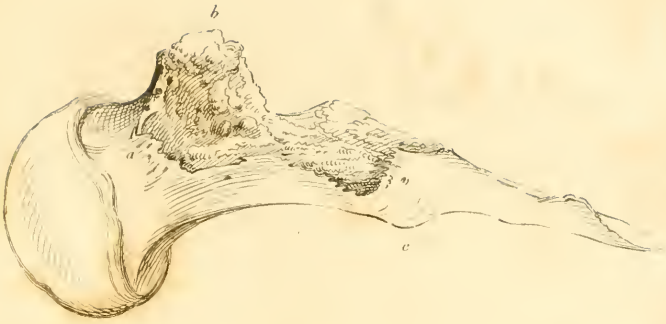
Fig. 2. The appearance of the fractured bone belonging to the same person.

a. The edge of the fracture in the neck of the bone, nearest to the head.

b. That part of the great trochanter which remains.

c. The little trochanter.

There is no other case on record in which a person survived after such an injury of the neck of the bone from gun-shot. There was an analogous case after the battle of Waterloo, in which the head of the bone was injured also; but this man would not submit to the operation until it was too late, when I declined doing it. He died two days after. There was a case after the battle of Toulouse in which the injury was not so severe. This officer died at Plymouth four months afterwards, having suffered great misery.



London Published Jany 1821 by Messrs Burgess & Hill, N.º 55 Great Windmill Street

Fig. 1

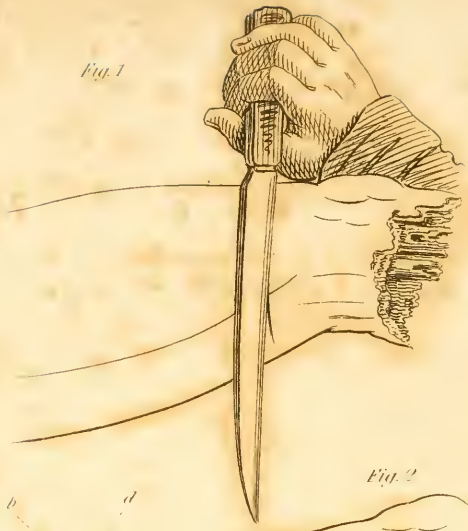


Fig. 2

Fig. 3.

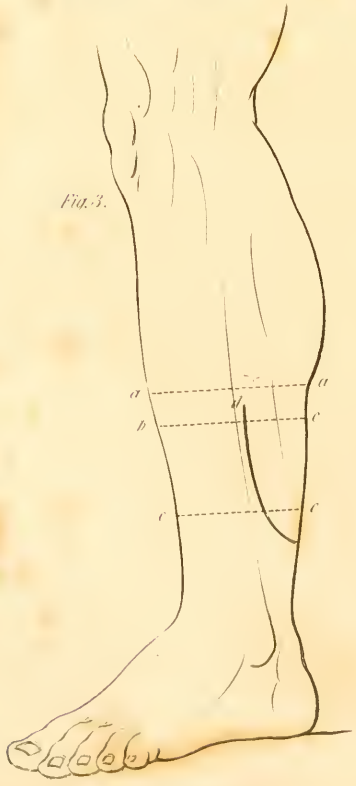


Fig. 4.

Fig. 5.

PLATE III.

Fig. 1. Shows the position of the amputating knife on commencing the first circular incision, as described page 385.

Fig. 2. Represents the flap operation, as described page 400.

a. The commencement of the first incision for the formation of the flap.

b. The semicircular incision joining the two angles of the flap.

c. A line intended to show the place where the bones are to be sawed through.

d. The sharp spine of the tibia sawed off.

Fig. 3. Mr. Hey's operation, as described page 407.

a. a. The highest circular line where the bones are to be sawed through.

d. The course the catlin ought to take in the formation of the flap.

e. e. A circular line, a little below which the catlin ought to be brought out.

b. c. A circular line made one inch below the superior one, where the integuments are to be divided.

b. to *d.* Marks the course of the incision through the skin, on the anterior part of the leg.

Fig. 4. Represents the anterior line of incision in the operation described page 405.

a. The line of incision in the operation recommended by Chopart and Lisfranc.

Fig. 5. Shows the line of incision for the formation of a flap from the sole of the foot, in the same operation as Figure 4, which is to be raised up to cover the tarsus, when the metatarsal bones and the toes are removed.

PLATE IV.

Fig. 1. Shows the position of the patient in the operation at the shoulder-joint, described at page 440, with the tourniquet, prepared for compressing the subclavian artery, held in the hand of an assistant from behind.

a. The inner incision, commencing a little below the point of the acromion.

b. The outer incision.

Fig. 2. Represents the operations on the hand in four parts, described pages 545 et seq.

1. *a*. The first incision on the inside of the thumb on the back of the hand, which is carried down to the joint with the carpus, and brought over with a gentle slope to the outside.

b. A similar incision on the inner side of the hand, joining the two ends of the first incision.

2 and 3. Two ways of removing the first phalanx of the fingers, as described at page 547.

4. Of the second phalanx, nearly in the same manner.

Fig. 3. Represents the first three incisions in the operation recommended by the Baron Larrey, page 461.

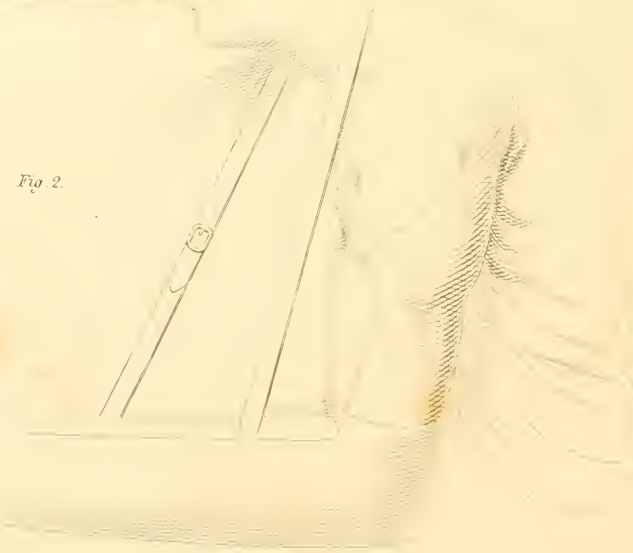
Fig 1

Fig. 2.

Fig. 3.

Fig. 1.

Fig. 2.



Milton sc

PLATE V.

Fig. 1. Represents Thomas Ellard, whose case is related page 490.

A. The left shoulder very much thickened and enlarged.

B. Shows where the ball entered.

C. Shows where it made its exit.

D. At this place an abscess had formed, which was opened, and from which two or three small fragments of bone were extracted.

The figure also shows the semilunar incision, which commenced at the anterior shot-hole B, and was carried to the opposite side C, making a flap.

Fig. 2. The appearance of the arm, after the wound was healed.

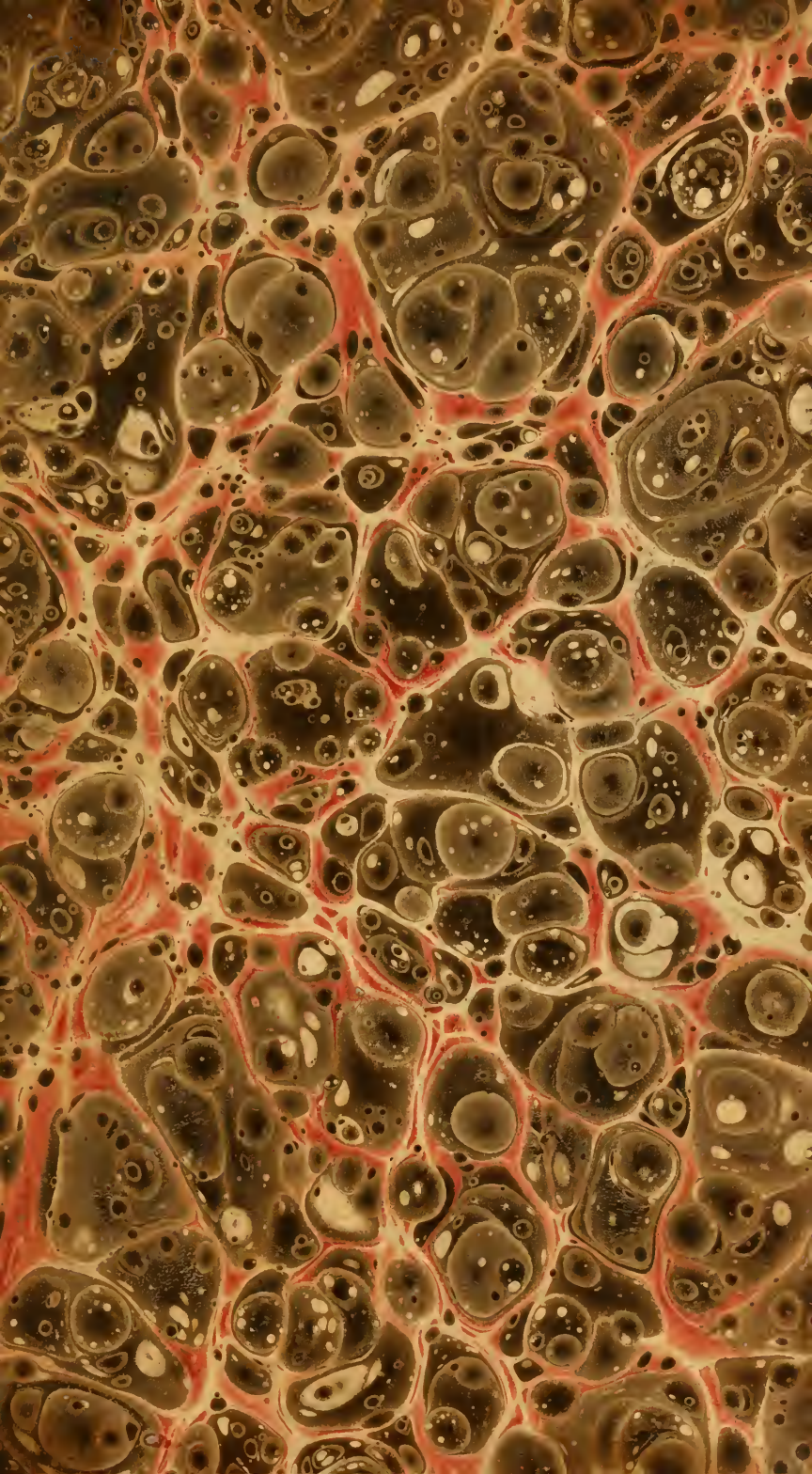
The author is indebted to the liberality of the Medical and Chirurgical Society, for the use of this Plate, as well as for permission to insert the case at length.

THE END.

LONDON:
PRINTED BY CHARLES WOOD,
Poppin's Court, Fleet Street.

RD96.3
827G

Date Due

~~APR 20 1951~~			

Demco 293-5